2017
APPENDIX

Center for Biofilm Engineering

Montana State University Bozeman

Reporting Period:
June 1, 2016–May 31, 2017
# TABLE OF CONTENTS

## RESEARCH
- CBE research areas
- 2016-2017 CBE grant-funded research activity
- New CBE research grants summary
- List of publications
- List of presentations
- News highlights
- CBE affiliated faculty and their specialties
- CBE affiliated faculty and staff awards and news

## EDUCATION
- Undergraduate students, 2016-17
- Graduate students, 2016-17
- MSU Student Research Celebration: CBE participants
- 2016-17 MSU student awards and news
- CBE Seminar Series: Fall 2016 and Spring 2017

## TECHNOLOGY TRANSFER
- List of CBE Industrial Associates, June 2016–May 2017
- Agenda: Summer 2016 Montana Biofilm Science & Technology Meeting
- Agenda: Summer 2016 Workshop
- Agenda: Winter 2017 CBE sponsored regulatory meeting
- Agenda: Winter 2017 CBE sponsored biofilm workshop
- News highlights
- Industrial and agency interactions

## OUTREACH
- News highlights
- Visiting researchers
- CBE tours
- Web image library use summary

## FACILITIES
- Overview and description of CBE facilities
CBE RESEARCH AREAS

Research at the Center for Biofilm Engineering is driven by industrial, environmental, and health issues of national importance. CBE research has contributed new insights into microbial processes in a wide variety of contexts.

CBE RESEARCH:
- is motivated by industrial concerns and involvement of industry partners;
- is conducted at multiple scales of observation, from molecular to field-scale;
- involves interdisciplinary investigations;
- provides relevant research opportunities for undergraduate and graduate students;
- is enhanced by productive collaborations with researchers at other institutions;
- is funded by competitive grants and industrial memberships; and
- produces both fundamental and applied results.

The CBE’s long history of research success results from adaptability to new information and analytical technologies, and flexibility in addressing biofilm issues in comprehensive ways, using its deep bench of MSU researchers with diverse specialties in biofilm studies.

APPLIED RESEARCH AREAS & PROJECTS

Biofilm control strategies  antimicrobial efficacy | biocides | bioelectric effect | disinfectants | inhibitory coatings | bioactive compounds

Energy solutions  biofuels | product souring | coal bed methane production | microbial fuel cells

Environmental technologies  bioremediation | wetlands | CO₂ sequestration | biobarriers | biomineralization | microbes & mining issues

Health/medical biofilms  chronic wound healing | catheter infections | oral health | food safety

Industrial systems & processes  biofouling | biocorrosion | product contamination | microbe-metal interactions

Standardized methods  product claims | regulatory issues | ASTM methods acceptance

Water systems  drinking water quality | premise plumbing | water treatment | distribution systems

FUNDAMENTAL TOPICS

Biofilms in nature  microbes in hot & cold environments | role of biofilms in natural processes | biomimetics | biogeochemistry

Cellular/intracellular  phenotype | genetics | metabolic pathways | proteomics

Multicellular/extracellular  flow and transport in biofilm systems | material properties | quorum sensing | structure-function | heterogeneities | matrix

Ecology/physiology  population characterization | spatial and temporal population dynamics

ANALYTICAL TOOLS & TECHNIQUES

Instrumentation  microscopy | nuclear magnetic resonance imaging | gas chromatography | microfluidics

Methods development  experimental design | variability | ruggedness | repeatability | statistical evaluation

Modeling  cellular automata modeling | mathematics | hydrodynamics | cohesive strength

Basic microbiology techniques  total and direct counts | MIC determination | viable cell counts

Molecular biology techniques  DNA extraction | PCR | DGGE | microarrays | sequencing
### RESEARCH:

#### 2016–2017 CBE GRANT-FUNDED RESEARCH ACTIVITY

Current CBE Research Grants for Fiscal Year 2017 (July 1, 2016 to June 30, 2017)

<table>
<thead>
<tr>
<th>Research Area</th>
<th>Title</th>
<th>Principal Investigator</th>
<th>Funding Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biofilm Mechanics</td>
<td>Exploring Biofilm Material Properties with Micromechanical Tools</td>
<td>Wilking</td>
<td>NSF</td>
</tr>
<tr>
<td>Biofilm Mechanics</td>
<td>Development of Robust Microbial Communities through Engineered Biofilms</td>
<td>Carlson</td>
<td>ARREOF</td>
</tr>
<tr>
<td>Biofilm Mechanics</td>
<td>VIPER: Viral Interdiction through Population Engineering and Restructuring</td>
<td>Chang</td>
<td>NCSU</td>
</tr>
<tr>
<td>Biofilms in Nature</td>
<td>USGS-BigHorn</td>
<td>Fields</td>
<td>USGS</td>
</tr>
<tr>
<td>Biofilms in Nature</td>
<td>Riverine Carbon Cycling as a Function of Seasonality</td>
<td>Foreman</td>
<td>MONACA</td>
</tr>
<tr>
<td>Biofilms in Nature</td>
<td>Continued Monitoring of the Bridger Bowl Wetland System</td>
<td>Stein</td>
<td>BRIBOW</td>
</tr>
<tr>
<td>Biofilms in Nature</td>
<td>Multidimensional omics characterization of microbial metabolism and dissolved organic matter in Antarctica</td>
<td>Foreman</td>
<td>NSF</td>
</tr>
<tr>
<td>Biofilms in Nature</td>
<td>Research on Airborne Ice Nucleating Species (RAINS)</td>
<td>D’Andrilli</td>
<td>FLOUNI</td>
</tr>
<tr>
<td>Education</td>
<td>Improving Montana community health through graduate education</td>
<td>Camper</td>
<td>NIH</td>
</tr>
<tr>
<td>Energy Solutions</td>
<td>SEP Collaborative Research: Alkaliphilic microalgal-based sustainable &amp; scalable processes for renewable fuels and products</td>
<td>Gerlach</td>
<td>NSF</td>
</tr>
<tr>
<td>Energy Solutions</td>
<td>Lipid derived biofuels: Bicarbonate induced triacylglycerol accumulation in microalgae</td>
<td>Peyton</td>
<td>Church &amp; Dwight</td>
</tr>
<tr>
<td>Environmental Substance Technologies</td>
<td>Nutrient and Water Integration and recycling for sustainable algal biorefineries</td>
<td>Gerlach</td>
<td>U of Toledo-DOE</td>
</tr>
<tr>
<td>Environmental Substance Technologies</td>
<td>Cooperative research program on constructed wetland design and implementation</td>
<td>Stein</td>
<td>USFWS</td>
</tr>
<tr>
<td>Environmental Substance Technologies</td>
<td>Design and implementation of pilot vertical flow treatment wetland systems at Bridger Bowl</td>
<td>Stein</td>
<td>MT DEQ</td>
</tr>
<tr>
<td>Environmental Substance Technologies</td>
<td>Using Biomineralization Sealing for Leakage Mitigation in Shale during CO2 Sequestration</td>
<td>Gerlach</td>
<td>MT Emergent Technologies-DOE</td>
</tr>
<tr>
<td>Environmental Substance Technologies</td>
<td>Use of Saturated/Submerged Rock Fills for Water Quality Management</td>
<td>Peyton</td>
<td>SRK Consulting</td>
</tr>
<tr>
<td>Environmental Substance Technologies</td>
<td>Nitrifying WasteWater Biofilms and the Influence of Emerging Contaminants*</td>
<td>Lauchnor</td>
<td>USGS</td>
</tr>
<tr>
<td>Environmental Substance Technologies</td>
<td>Collaborative Research: Connecting omics to physical environment in community microbial ecology</td>
<td>Zhang</td>
<td>NSF</td>
</tr>
<tr>
<td>Environmental Substance Technologies</td>
<td>Application of biofilm covered carbon particles as a microbial inoculum delivery system in weathered PCB contaminated sediment</td>
<td>Stewart</td>
<td>U of Maryland-DOD</td>
</tr>
<tr>
<td>Environmental Substance Technologies</td>
<td>Saturated rock fill phase 3 laboratory column testing</td>
<td>Peyton</td>
<td>SRK Consulting</td>
</tr>
<tr>
<td>Environmental Substance Technologies</td>
<td>Sulfate reducer biofilm transcriptomics and thermodynamics under transient conditions</td>
<td>Fields</td>
<td>EXXMOB002</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>-----------------------------------------------------------------</td>
<td>--------</td>
<td>-------</td>
</tr>
<tr>
<td><strong>Industrial Systems</strong></td>
<td>Engineering systems for the eradication of biofilms in metal working and machining fluids</td>
<td>Foreman</td>
<td>NSF</td>
</tr>
<tr>
<td><strong>Instrumentation</strong></td>
<td>MRI: Acquisition of Optical Coherence Tomography Instrumentation at Montana State University</td>
<td>Wilking</td>
<td>NSF</td>
</tr>
<tr>
<td><strong>Medical Biofilms</strong></td>
<td>Spatiotemporal distribution of oxygen in biofilm infections</td>
<td>Stewart</td>
<td>NIH</td>
</tr>
<tr>
<td><strong>Medical Biofilms</strong></td>
<td>Resensitization of Bacteria in Biofilms to Antibiotics</td>
<td>Stewart</td>
<td>DOD (USAMRAA)</td>
</tr>
<tr>
<td><strong>Methods Development</strong></td>
<td>Development and use of standard methods for the growth, treatment, sampling and analysis of biofilm bacteria</td>
<td>Goeres</td>
<td>EPA</td>
</tr>
<tr>
<td><strong>Methods Development</strong></td>
<td>Methods to assess biofilm prevention on medical devices</td>
<td>Goeres</td>
<td>Burroughs Wellcome Fund</td>
</tr>
<tr>
<td><strong>Methods Development</strong></td>
<td>Anti-biofilm technologies: Pathways to product development</td>
<td>Goeres</td>
<td>Burroughs Wellcome Fund</td>
</tr>
<tr>
<td><strong>Methods Development</strong></td>
<td>Antimicrobial Test Method - Statistical Support &amp; Consultation</td>
<td>Goeres</td>
<td>EPA</td>
</tr>
<tr>
<td><strong>Modeling</strong></td>
<td>Predictive Multiscale Modeling of Microbial Consortia Biofilms</td>
<td>Carlson</td>
<td>NIH</td>
</tr>
<tr>
<td><strong>Physiology &amp; Ecology</strong></td>
<td>Virtual institute for microbial stress &amp; survival</td>
<td>Fields</td>
<td>DOE/LBNL</td>
</tr>
<tr>
<td><strong>Physiology &amp; Ecology</strong></td>
<td>Collaborative Research: Hydrodynamic controls on microbial community dynamics</td>
<td>Cunningham &amp; Fields</td>
<td>NSF</td>
</tr>
<tr>
<td><strong>Water Systems</strong></td>
<td>Water, Our Voice to the Future: Climate change adaptation and waterborne disease prevention on the Crow Reservation</td>
<td>Camper</td>
<td>Little Big Horn College</td>
</tr>
</tbody>
</table>

*Denotes a project running through a different MSU department, but involving collaboration with CBE researchers and/or use of CBE facilities.

**List of Acronyms**

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARREOF</td>
<td>US Army Research Office</td>
</tr>
<tr>
<td>DOD</td>
<td>US Department of Defense</td>
</tr>
<tr>
<td>DOE</td>
<td>US Department of Energy</td>
</tr>
<tr>
<td>EPA</td>
<td>US Environmental Protection Agency</td>
</tr>
<tr>
<td>EXXMOB002</td>
<td>Exxon Mobil</td>
</tr>
<tr>
<td>FLOUNI</td>
<td>University of Florida</td>
</tr>
<tr>
<td>LBNL</td>
<td>Lawrence Berkeley National Lab</td>
</tr>
<tr>
<td>MT DEQ</td>
<td>Montana Department of Environmental Quality</td>
</tr>
<tr>
<td>NASA</td>
<td>National Aeronautics and Space Administration</td>
</tr>
<tr>
<td>NCSU</td>
<td>North Carolina State University</td>
</tr>
<tr>
<td>NIH</td>
<td>National Institutes of Health</td>
</tr>
<tr>
<td>NSF</td>
<td>National Science Foundation</td>
</tr>
<tr>
<td>USFWS</td>
<td>US Fish and Wildlife Service</td>
</tr>
<tr>
<td>USGS</td>
<td>US Geological Survey</td>
</tr>
</tbody>
</table>
## FY17 New CBE Research Grants (July 1, 2016 to June 30, 2017)

<table>
<thead>
<tr>
<th>Sponsor</th>
<th>Title</th>
<th>PI</th>
<th>Period</th>
<th>Award Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridger Bowl Inc</td>
<td>Continued Monitoring of the Bridger Bowl Wetland System*</td>
<td>Otto Stein</td>
<td>2 yr 2 months</td>
<td>$24,999</td>
</tr>
<tr>
<td>EPA</td>
<td>Antimicrobial Test Method – Statistical Support &amp; Consultation</td>
<td>Darla Goeres</td>
<td>3 yr</td>
<td>$104,859</td>
</tr>
<tr>
<td>Exxon Mobil</td>
<td>Sulfate reducer biofilm transcriptomics and thermodynamics under transient conditions</td>
<td>Matthew Fields</td>
<td>1 yr</td>
<td>$160,000</td>
</tr>
<tr>
<td>LAWBER</td>
<td>Virtual Institute for Microbial Stress and Survival/Environmental Stress Pathways*</td>
<td>Matthew Fields</td>
<td>1 Yr</td>
<td>$389,027</td>
</tr>
<tr>
<td>NIH</td>
<td>Predictive Multiscale Modeling of Microbial Consortia Biofilms*</td>
<td>Ross Carlson</td>
<td>1 yr</td>
<td>$323,819</td>
</tr>
<tr>
<td>North Carolina State University (DARPA)</td>
<td>VVIPER: Viral Interdiction through Population Engineering and Restructuring</td>
<td>Connie Wilking</td>
<td>5 yr</td>
<td>$1,292,000</td>
</tr>
<tr>
<td>NSF</td>
<td>Engineering systems for the eradication of biofilms in metal working and machine fluids</td>
<td>Christine Foreman</td>
<td>1 yr</td>
<td>$50,000</td>
</tr>
<tr>
<td>NSF</td>
<td>MRI: Acquisition of Optical Coherence Tomography Instrumentation of Montana State University</td>
<td>James Wilking</td>
<td>1 yr</td>
<td>$105,000</td>
</tr>
<tr>
<td>University of Florida</td>
<td>Research on Airborne Ice Nucleating Species</td>
<td>Juliana D'Andrilli</td>
<td>1 yr</td>
<td>$14,988</td>
</tr>
<tr>
<td>US Army Research Office</td>
<td>Development of Robust Microbial Communities through Engineered Biofilms</td>
<td>Ross Carlson</td>
<td>3 yr</td>
<td>$655,400</td>
</tr>
<tr>
<td>US Geological Survey</td>
<td>USGS-BigHorn*</td>
<td>Fields</td>
<td>2 yr</td>
<td>$7,000</td>
</tr>
</tbody>
</table>

**Total Grant Awards to CBE in Fiscal Year 2017** | **$3,127,092**

*Additional funding awarded to existing grants in FY17 (budget increased by the amount listed)*
RESEARCH:
PUBLICATIONS
June 2016–May 2017

2016 Publications

NOTE: 2016-001 through 2016-012 are listed in 2016 Appendix


2017 Publications


Appendix ToC


* Industrial or Federal Agency Co-author
^ Undergraduate Student

Appendix ToC
RESEARCH:
PRESENTATIONS
June 2016–May 2017


The following CBE researchers presented their work at Goldschmidt Conference, Yokohama Japan, June 26–July 1, 2016:

Marnie Feder, CBE postdoctoral researcher, presented “Advancing ureolysis driven mineral sealing strategies for environmental engineering applications.”

Robin Gerlach, professor, chemical & biological engineering, presented “Biofilm-mediated mineral precipitation technology – From the microscale to the field-scale.”


The following CBE doctoral students presented research at 6th Annual Conference on Algal, Biomass, Biofuels, and Bioproducts, San Diego, CA, June 26–29, 2016:

Tisza Bell, PhD candidate, microbiology & immunology, presented a platform presentation “Monitoring community ecology in wastewater treatment lagoons for the production of algal biodiesel.”

Karen Moll, PhD student, microbiology & immunology presented the poster “Genomics of novel high biofuel-producing diatom.”

Muneeb Rathore, PhD student, chemical & biological engineering, presented two posters “Novel algal biofilm reactor with harvesting mechanism for enhanced biomass production” and “Promoting lipid accumulation in Chlorella vulgaris UTEX395 using nitrogen limitation and bicarbonate amendment under different nitrogen regimes.”


The following CBE researchers presented posters at the ENIGMA meeting, Berkeley, CA, August 1–6, 2016:

Sara Altenburg, CBE research lab manager, presented “Particle size impacts carrying-capacity for biofilm via reduction of free pore space and limitation for required resource ratio.”

Laura Camilleri, PhD candidate, microbiology & immunology, presented “Differential activity levels for bacterial and archaeal populations in an interdomain biofilm.”

Matthew Fields, CBE director, delivered an oral presentation “Soil particle mesogenomics—‘Microparticles’.”

Lauren Franco, PhD student, microbiology & immunology, presented “Resource ratio impacts Desulfovibrio vulgaris reduction and response to Cr(VI).”

Gregory Krantz, PhD student, microbiology & immunology, presented “Bulk phase resource ratio alters electron transfer mechanisms in sulfate-reducing biofilms grown on metal.”


Gregory Krantz, PhD candidate, microbiology & immunology, presented “Bulk phase resource ratio alters electron transfer mechanisms in sulfate-reducing biofilms grown on metal,” at ISME Conference in Montreal, Quebec, Canada, August 21–26, 2016.

Phil Stewart, professor, chemical & biological engineering, as an invited speaker presented “Antimicrobial tolerance in biofilms: Physics, chemistry, biology,” at Vikki Biocenter Lecture, University of Helsinki, Finland, August 22, 2016.
Sarah Codd, professor, mechanical and industrial engineering, presented an invited lecture “Characterizing gels by NMR porous media methods: Direct measurement of glass dynamics and mesh network size in a solvent polymer system by multidimensional relaxometry and diffusometry,” at the 13th International Conference on Magnetic Resonance in Porous Media, Bologna, Italy, September 4–8, 2016.

Anne Camper, professor, civil engineering, presented “Water, our voice to the future: climate change adaptation and waterborne disease prevention on the Crow Reservation” at EPA’s 2016 STAR Tribal Research Meeting at Research Triangle Park in Durham, NC from September 20–21, 2016.

The following CBE faculty and students presented research at GSA, Denver, CO, September 25–28, 2016:

Oral Presentations:
Adrienne Phillips, assistant professor, civil engineering: “Biomineralization: A strategy to modify permeability in the subsurface.”

Katie Davis, PhD student, civil engineering: “Identifying the source, pathways, and rates of enhanced microbial coalbed methane.”

Poster presentations:
Katie Davis, PhD student, civil engineering: “Scale up of microbially enhanced coalbed methane strategies using a column upflow reactor.” Katie received the Outstanding Poster Presentation Award for the Environmental and Engineering Geology Division Student Research Competition.

Drew Norton, masters student, civil engineering: “Visualizing and quantifying biomineralization in a wellbore analog reactor.”

Margaux Meslé, CBE postdoctoral research associate, presented “Design of a small-scale high-pressure reactor system to study microbial bioconversion of coal to methane,” at GSA (Geological Society of America), Denver, CO, September 27, 2016.

Darla Goeres, associate research professor, chemical & biological engineering, was invited to present “The need for standardized biofilm methods for medically relevant applications” at the Antimicrobial Resistance in Microbial Biofilm and Options for Treatment Conference, Ghent, Belgium, October 5–7, 2016.

Diane Walker, CBE research engineer, as an invited speaker presented “Modifications to the CDC biofilm growth reactor method (ASTM E2562-12) for mixed species and Legionella pneumophila studies,” at the RAMC (Recent Advances in Microbial Control) Meeting in San Diego, CA, October 9–12, 2016.

John Doyle, project coordinator, microbiology & immunology, and Mari Eggers, CBE research scientist, presented “Exploring effects of climate change on Tribal water and health,” at the American Water Resources Association Montana Conference in Anaconda, MT from October 12–14, 2016.

Phil Stewart, professor, chemical & biological engineering, as an invited speaker presented “Preventing biofilm infections” at Biofilms, Ecology, and Human Health Symposium, University of Michigan, Ann Arbor, MI, October 21, 2016.

Robin Gerlach, professor, chemical & biological engineering, presented “Alkaliphilic algal cultivation as a means for improved productivity and stability of algae-based production systems,” and was a moderator for the ‘Synthetic Biology for Algae and Consortia’ panel at the Algal Biomass Summit in Phoenix AZ, October 25, 2016.

The following CBE faculty presented research at Reservoir Microbiology Forum in London England, November 15–16, 2016:

Matthew Fields, CBE director: “Bulk phase resource ratio alters electron transfer mechanisms in sulfate-reducing biofilms grown on metal” and “Aqueous sulfate levels control methanogen diversity and activity in subsurface coal seams.”

Robin Gerlach, professor, chemical & biological engineering: “Biocementation for wellbore integrity restoration and enhanced resource recovery,” and “Identifying the source, pathways, and rates of microbial coalbed methane production.”

Phil Stewart, professor, chemical & biological engineering, presented “Biofilm control and antimicrobial surfaces,” as an invited speaker at the National Academies of Sciences, Engineering, and Medicine Conference, Washington, DC, December 1, 2016.

Matthew Fields, CBE director, gave a workshop during the 2017 Genomic Sciences Program Annual Principal Investigator PI Meeting in Washington, DC, February 6–8, 2017.

Heidi Smith, CBE postdoctoral researcher, presented a poster entitled “Temporal variability and microbial activity in groundwater ecosystems,” at the DOE PI Meeting in Washington, DC, February 5–8, 2017.


Neerja Zambare, PhD student, chemical & biological engineering, presented “Optimizing microbially induced calcite precipitation under radial flow conditions,” at the 253rd American Chemical Society Meeting & Exposition in San Francisco, CA, April 2–6, 2017.

Garth James, associate research professor, chemical & biological engineering, presented “Biofilms in chronic wounds” during the 2017 Society for Biomaterials Meeting in Minneapolis, MN, April 7–8, 2017.

Emily Hultin, undergraduate, chemical & biological engineering, presented a poster entitled “Riverine carbon cycling as a function of seasonality,” at the Montana Academy of Science, Butte, MT, April 7, 2017.

The following CBE researchers presented research at the National Council on Undergraduate Research, Memphis, TN, April 6–8, 2017:

Emily Hultin, undergraduate, chemical & biological engineering presented “Characterization of Antarctic algae for biofuel potential.” (oral presentation)

Taylor Oeschger, undergraduate, chemical & biological engineering, presented “Application of laser etching and 3D printed polymers for modeling ice vein habitats.” (oral presentation)

Rita Park, undergraduate student, microbiology & immunology, presented “Effect of coal particle size on microbial methanogenesis in the presence of oxygen.” (poster presentation)

Hanna Showers, undergraduate, chemical & biological engineering, presented “Rheological and atomic force microscopy investigation of carotenoid pigmented Antarctic heterotrophic bacteria.” (oral presentation)

MiKally Williams, undergraduate, chemical & biological engineering, presented “Growth and applications of biosurfactants in polar regions and space frontiers,” at the Montana Space Grant Consortium Student Research Symposium in Bozeman, MT on April 8, 2017.

Darla Goeres, associate research professor, chemical & biological engineering, presented “ISO Method 846 Part C: Update on modifications to make the test quantitative” at the IBRG Spring Meeting 2017 in Berlin, Germany from April 25–27, 2017.

**NEWS HIGHLIGHTS**

**MSU team recognized for technology that seals oil and gas leaks**
CBE affiliated faculty Adrienne Phillips, Robin Gerlach, and Al Cunningham were featured by MSU News for their research that has demonstrated the potential for biofilm and mineral-producing bacteria to stop tiny, hard-to-reach leaks in underground oil and gas wells.

Read the article at MSU News: “MSU team shows biofilm and mineral-producing bacteria have potential for plugging oil and gas leaks”

The story was also featured in the Bozeman Daily Chronicle: “MSU research shows bacteria could plug oil and gas leaks”

**CBE biostatistician part of landmark study correlating hand-washing and health insurance claims**
Al Parker, CBE biostatistician, provided statistical analysis on an important study that is the first to prove a direct link between the availability of a comprehensive hand hygiene program and a reduction in healthcare insurance claims tied to hand hygiene preventable illnesses. The study was conducted by Medical Mutual of Ohio and GOJO, a leading producer of skin health and hygiene solutions for commercial use. The full article “Impact of a comprehensive workplace hand hygiene program on employer healthcare insurance claims plus costs, absenteeism, and employee perceptions and practices,” was featured in the June 2016 issue of the Journal of Occupational and Environmental Medicine.

Related press release: “PURELL® hand sanitizer and hand sanitizing wipes in workplace helped reduce healthcare insurance claims for cold and flu by 24%”


**CBE faculty member to study biofilms and draught beer lines**
CBE faculty Darla Goeres, associate research professor in chemical and biological engineering, partnered with the Brewers Association and NSF International Applied Research Center (ARC) to conduct a draught beer line study. This groundbreaking study will draw on the combined expertise of the ARC and the CBE, which includes decades of experience researching biofilm in industrial settings and internationally recognized quality standards related to public health and sanitation. “By combining the method development expertise of the CBE with the unique, rapid testing ability of the NSF International Applied Research Center, we are confident that a reliable, reproducible method will be created to assist the brewing industry with an effective draught beer line standard cleaning method,” stated Goeres.

Read more about this project at: “BA addresses draught beer quality best practices with groundbreaking study”

**CBE researchers receive grant to address water issues on Crow Reservation**
CBE researchers Mari Eggers, research scientist, and Anne Camper, Regents Professor in civil engineering, are part of a team that recently received a $5 million grant to address well water issues on the Crow Reservation in southeastern Montana.

Read the full story at MSU News: “MSU, Little Big Horn College researchers receive grant to address well water issues on Crow Reservation”
CBE researchers receive funding to study eco-friendly alternatives to cleaning with biocides
CBE affiliated faculty Christine Foreman, associate professor in chemical and biological engineering, Kevin Cook, associate professor in mechanical engineering, and Markus Dieser, assistant research professor, were awarded funding from the National Science Foundation’s Civil, Mechanical and Manufacturing Innovation program for their proposal “Eradication of microbial contamination in metalworking fluids.” As explained in the proposal to NSF, in many manufacturing processes, metalworking fluids (MWFs) are applied to ensure reduced tool wear and workpiece quality. However, microbial contamination is a significant factor in the degradation of these fluids, causing biofouling and corrosion of equipment, imperilment of product quality, and posing occupational safety risks. Even after meticulous cleaning and the use of biocides, biofilms residing within the inaccessible regions of the system rapidly re-populate in MWFs. The study will investigate a novel MWF management strategy for biofilm eradication as an eco-friendly alternative to biocides.

CBE faculty member awarded grant from US Army Research Office
CBE faculty member Ross Carlson, professor in MSU’s Department of Chemical and Biological Engineering, was awarded a three-year grant from the US Army Research Office for his research on the role different species of bacteria play in microbial communities. Read about Carlson’s research at MSU News: “MSU engineering professor awarded U.S. Army Research Office grant”

CBE faculty member receives $1.3M to develop virus fighting technology
CBE affiliated faculty member Connie Chang, assistant professor in MSU’s Department of Chemical and Biological Engineering, received a $1.3 million grant from the Defense Advanced Research Projects Agency (DARPA), an independent agency of the U.S. Department of Defense that funds high-risk, high-reward projects. Chang and her research group will explore the use of a sophisticated method called drop-based microfluidics for producing therapeutic interfering particles, or TIPS, for treating influenza. Read more about Dr. Chang’s research at MSU News: “MSU researcher receives $1.3 million to develop virus-fighting technology”

CBE researchers publish study on glacial carbon cycling in Nature Geoscience
Heidi Smith, CBE postdoctoral researcher, and Christine Foreman, CBE affiliated faculty member and associate professor of chemical and biological engineering, were co-authors of a paper published in the prestigious journal Nature Geoscience. The paper “Microbial formation of labile organic carbon in Antarctic glacial environments,” explains an undiscovered dynamic carbon cycle in melting glaciers in the Arctic and Antarctic that has global implications as the bulk of Earth’s glaciers shrink in response to a warming climate. Read more about their publication at MSU News: “MSU scientists publish study on glacial carbon cycle”

The article was also featured on the NSF website: https://www.nsf.gov/news/news_summ.jsp?cntn_id=191512&org=NSF&from=news

## RESEARCH:

### CBE Affiliated Faculty and Their Specialties, 2016–2017

<table>
<thead>
<tr>
<th>NAME</th>
<th>DEPARTMENT</th>
<th>SPECIALTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elliott Barnhart</td>
<td>Center for Biofilm Engineering</td>
<td>Environmental biotechnology</td>
</tr>
<tr>
<td>Jennifer Brown</td>
<td>Chemical &amp; Biological Engineering</td>
<td>Rheology and biofilm mechanics</td>
</tr>
<tr>
<td>Anne Camper</td>
<td>Civil Engineering</td>
<td>Biofilms in environmental systems; water distribution</td>
</tr>
<tr>
<td>Ross Carlson</td>
<td>Chemical &amp; Biological Engineering</td>
<td>Metabolic engineering, metabolic networks; chronic wounds</td>
</tr>
<tr>
<td>Connie Chang</td>
<td>Chemical &amp; Biological Engineering</td>
<td>Microfluidics</td>
</tr>
<tr>
<td>Sarah Codd</td>
<td>Mechanical &amp; Industrial Engineering</td>
<td>Magnetic resonance imaging</td>
</tr>
<tr>
<td>Kevin Cook</td>
<td>Mechanical &amp; Industrial Engineering</td>
<td>Tool and machine design</td>
</tr>
<tr>
<td>Al Cunningham</td>
<td>Civil Engineering</td>
<td>Subsurface biotechnology and bioremediation</td>
</tr>
<tr>
<td>Markus Dieser</td>
<td>Chemical &amp; Biological Engineering</td>
<td>Ecology</td>
</tr>
<tr>
<td>Matthew Fields</td>
<td>Microbiology &amp; Immunology</td>
<td>Environmental biofilms</td>
</tr>
<tr>
<td>Christine Foreman</td>
<td>Chemical &amp; Biological Engineering</td>
<td>Microbial ecology in cold temperature environments</td>
</tr>
<tr>
<td>Michael Franklin</td>
<td>Microbiology &amp; Immunology</td>
<td>Molecular genetics, gene expression, alginate biosynthesis; <em>Pseudomonas</em></td>
</tr>
<tr>
<td>Robin Gerlach</td>
<td>Chemical &amp; Biological Engineering</td>
<td>Environmental biotechnology and bioremediation</td>
</tr>
<tr>
<td>Darla Goeres</td>
<td>Chemical &amp; Biological Engineering</td>
<td>Standardized biofilm methods</td>
</tr>
<tr>
<td>Martin Hamilton</td>
<td>Mathematical Sciences</td>
<td>Mathematics and statistics</td>
</tr>
<tr>
<td>Roland Hatzenpichler</td>
<td>Chemistry &amp; Biochemistry</td>
<td>Microbial activity</td>
</tr>
<tr>
<td>Jeffrey Heys</td>
<td>Chemical &amp; Biological Engineering</td>
<td>Fluid-structure interactions</td>
</tr>
<tr>
<td>Garth James</td>
<td>Chemical &amp; Biological Engineering</td>
<td>Medical biofilms</td>
</tr>
<tr>
<td>Kelly Kirker</td>
<td>Chemical &amp; Biological Engineering</td>
<td>Medical biofilms</td>
</tr>
<tr>
<td>Ellen Lauchnor</td>
<td>Civil Engineering</td>
<td>Environmental engineering</td>
</tr>
<tr>
<td>Zbigniew Lewandowski</td>
<td>Civil Engineering</td>
<td>Microsensors, chemical gradients, biofilm structure</td>
</tr>
<tr>
<td>Albert Parker</td>
<td>Mathematical Sciences</td>
<td>Mathematics and statistics</td>
</tr>
<tr>
<td>Brent Peyton</td>
<td>Chemical &amp; Biological Engineering</td>
<td>Environmental biotechnology and bioremediation</td>
</tr>
<tr>
<td>Adrienne Phillips</td>
<td>Civil Engineering</td>
<td>Environmental engineering</td>
</tr>
<tr>
<td>Elinor Pulcini</td>
<td>Chemical &amp; Biological Engineering</td>
<td>Medical biofilms</td>
</tr>
<tr>
<td>Abbie Richards</td>
<td>Chemical &amp; Biological Engineering</td>
<td>Environmental biotechnology</td>
</tr>
<tr>
<td>Joseph Seymour</td>
<td>Chemical &amp; Biological Engineering</td>
<td>Magnetic resonance imaging</td>
</tr>
<tr>
<td>Dana Skorupa</td>
<td>Chemical &amp; Biological Engineering</td>
<td>Carbon capture sequestration</td>
</tr>
<tr>
<td>Otto Stein</td>
<td>Civil Engineering</td>
<td>Engineered waste remediation</td>
</tr>
<tr>
<td>Phil Stewart</td>
<td>Chemical &amp; Biological Engineering</td>
<td>Biofilm control strategies</td>
</tr>
<tr>
<td>Paul Sturman</td>
<td>Civil Engineering</td>
<td>Biofilms in waste remediation and industrial systems</td>
</tr>
<tr>
<td>James Wilking</td>
<td>Chemical &amp; Biological Engineering</td>
<td>Physical and material biofilm properties</td>
</tr>
<tr>
<td>Tianyu Zhang</td>
<td>Mathematical Sciences</td>
<td>Mathematical modeling</td>
</tr>
</tbody>
</table>
CBE Affiliated Faculty Awards & News

2017 College of Engineering Awards
MSU’s College of Engineering honored faculty, staff, and students at its annual awards luncheon on May 3, 2017. Center for Biofilm Engineering affiliated faculty member Christine Foreman received the college’s Excellence in Advancing Diversity Award. The award is given to a faculty or staff member engaged in advancing the careers of underrepresented people, and creating and championing diversity at Montana State University.

2016–2017 Tenure and Non-tenure Track Faculty Appointments
Roland Hatzenpichler was appointed to MSU’s Department of Chemistry and Biochemistry as an assistant professor. Roland received his PhD in microbial ecology from the University of Vienna in Austria in 2011, and recently completed a postdoctoral scholar position in geobiology at the California Institute of Technology. Roland’s research interest is in the function and activity of the “uncultivated majority” of microorganisms, and how their physiology impacts the environment across a range of scales, from micron to global. Roland also joined the CBE as an affiliated faculty member. For more information on Roland’s work, visit his website: www.environmental-microbiology.com

Two CBE postdoctoral researchers were recently appointed to assistant research professor positions in MSU’s Department of Chemical and Biological Engineering.

Markus Dieser received his PhD in ecology and environmental sciences from Montana State University in 2009. He joined the lab of Christine Foreman, associate professor chemical and biological engineering, as a postdoctoral fellow in 2013. Dieser's research focus is microbial ecology and biocorrosion.

Dana Skorupa earned her PhD in microbiology at MSU, studying acid-loving algae that inhabit some of Yellowstone National Park’s hot springs. Her current research focuses on trying to isolate novel, relevant, and robust extremophilic microorganisms from alkaline hot springs in Yellowstone’s Heart Lake Geyser Basin. Skorupa is also co-instructor of the MSU undergraduate course “Extreme Microbiology in Yellowstone,” which allows students to experience hands-on field study in Yellowstone National Park.

CBE Staff Awards & News

2017 Outstanding Researcher Award
Laura Boegli, CBE research scientist, received the 2017 Outstanding Researcher Award at 2017 Montana Biofilm Meeting. Laura was recognized for her many behind-the-scenes yet significant contributions to CBE education, research, and outreach. Laura spends many hours mentoring students demonstrating great commitment to the highest standards of laboratory organization and hygiene and is an outstanding example of the willingness to collaborate and share.

New Staff
CBE welcomed the following postdoctoral researchers to its staff:

Heejoon Park joined the lab of Ross Carlson, professor of chemical and biological engineering. Heejoon earned his PhD from the University of Wyoming where he studied the synthesis of bioconjugates (enzyme-magnetic nanoparticles) to utilize recyclable biocatalysts in biological processes. After earning his PhD, he worked as a research engineer at Lotte Petrochemical Corporation. At the CBE, Heejoon will be working on Carlson’s Army research project on the development of robust microbial communities through engineered biofilm. Heejoon enjoys playing all racquet sports, though tennis is his favorite. He’s very happy to have joined the CBE and knows it will be the perfect place to explore the magical biofilm turf.

Niranjan Ghimire joined Phil Stewart’s lab (professor of chemical and biological engineering). Niranjan earned his PhD in biomedical engineering from the University of South Dakota in May 2016. His research focus was developing antimicrobial orthopedic titanium material. Most recently, Niranjan worked as a research assistant in the Department of Biomedical

Appendix ToC
Engineering at the University of South Dakota. While at the CBE, he will be researching neutrophil-biofilm interactions in Dr. Stewart’s lab. Niranjan hails from Bharatpur in Chitwan district, Nepal. When he’s not in the lab, Niranjan likes to watch soccer and play tennis.

Viola Krukenberg is working for Roland Hatzenpichler, assistant professor in chemistry and biochemistry. Viola earned her PhD in marine microbiology from the University of Bremen, Germany in 2015. She was a postdoctoral researcher at the Max Planck Institute for Marine Microbiology before joining Dr. Hatzenpichler’s lab. Viola will be studying the physiology of uncultured microbes in deep-sea sediments to understand their function in the transformation of diverse carbon compounds.

****

Sarah Gorlitz-Burk joined the CBE as business manager. Sarah graduated from Montana State University with a bachelor’s degree in business accounting and has worked on campus for five years in MSU’s business office and audit services. As the CBE business manager, Sarah oversees all budget and fiscal matters. A Bozeman native, Sarah enjoys skiing, boating, and spending time with her husband and two children. The CBE is pleased to have found someone with her strong credentials and positive attitude to fill this key position.

Coltran Hophan-Nichols joined the CBE as a computer systems analyst. Coltran graduated from Montana State University in May 2015 with a bachelor’s degree in computer science. He has over four years of work experience in the information technology sector, both in operations and customer service. Coltran will be the CBE’s go-to person for IT analysis and support including desktop and server support, security, computer hardware and devices, and user training. In his free time, Coltran enjoys Montana’s outdoor activities including skiing, mountain biking, and hiking.
### Undergraduate Students: Summer 2016, Fall 2016, Spring 2017

*Graduating ‡ Native American

<table>
<thead>
<tr>
<th>#</th>
<th>Name</th>
<th>Degree</th>
<th>Major</th>
<th>Hometown</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Aman, Lydia (Lauchnor)</td>
<td>F</td>
<td>Chem &amp; Bio Eng</td>
<td>Homesdale, ID</td>
</tr>
<tr>
<td>2.</td>
<td>*Alagoz, Helin (Gerlach)</td>
<td>F</td>
<td>Chem &amp; Bio Eng</td>
<td>Turkey</td>
</tr>
<tr>
<td>3.</td>
<td>*Alanazi, Khalid (Wilking)</td>
<td>M</td>
<td>Chem &amp; Bio Eng</td>
<td>Saudi Arabia</td>
</tr>
<tr>
<td>5.</td>
<td>Avila, Nickolas (Gerlach)</td>
<td>M</td>
<td>Chem &amp; Bio Eng</td>
<td>Richland, WA</td>
</tr>
<tr>
<td>7.</td>
<td>Boise, Noelani (Peyton)</td>
<td>F</td>
<td>Land Resources &amp; Environ Sci</td>
<td>Livingston, MT</td>
</tr>
<tr>
<td>8.</td>
<td>Blossom, Taylor (Carlson)</td>
<td>M</td>
<td>Chem &amp; Bio Eng</td>
<td>Helena, MT</td>
</tr>
<tr>
<td>10.</td>
<td>Bowditch, Mason (Stein)</td>
<td>M</td>
<td>Civil &amp; Environ Eng</td>
<td>Missoula, MT</td>
</tr>
<tr>
<td>11.</td>
<td>Branine, Margaret (Hatzenpichler)</td>
<td>F</td>
<td>Microbiology &amp; Immunology</td>
<td>Canon City, CO</td>
</tr>
<tr>
<td>12.</td>
<td>*Burt, Kevin (Lauchnor)</td>
<td>M</td>
<td>Civil &amp; Environ Eng</td>
<td>Butte, MT</td>
</tr>
<tr>
<td>15.</td>
<td>*Dickerman, Grace (Goeres)</td>
<td>F</td>
<td>Chem &amp; Bio Eng</td>
<td>Cody, WY</td>
</tr>
<tr>
<td>16.</td>
<td>Dorle, Michael (Hatzenpichler)</td>
<td>M</td>
<td>Microbiology &amp; Immunology</td>
<td>St. Cloud, MN</td>
</tr>
<tr>
<td>17.</td>
<td>Dupuis, Lauren (Chang)</td>
<td>M</td>
<td>Chem &amp; Bio Eng</td>
<td>Polson, MT</td>
</tr>
<tr>
<td>18.</td>
<td>Eddy, Zachary (Fields)</td>
<td>M</td>
<td>Land Resources &amp; Environ Sci</td>
<td>Great Falls, MT</td>
</tr>
<tr>
<td>19.</td>
<td>Ekness, Thayne (Peyton)</td>
<td>M</td>
<td>Chem &amp; Bio Eng</td>
<td>Westby, MT</td>
</tr>
<tr>
<td>20.</td>
<td>*Exner, Katie (Chang)</td>
<td>F</td>
<td>Chem &amp; Bio Eng</td>
<td>Hamilton, MT</td>
</tr>
<tr>
<td>21.</td>
<td>*Franz, Brian (Fields)</td>
<td>M</td>
<td>Chem &amp; Bio Eng</td>
<td>Goodfield, IL</td>
</tr>
<tr>
<td>22.</td>
<td>*Fox, Amy (Chang)</td>
<td>F</td>
<td>Chem &amp; Bio Eng</td>
<td>Belgrade, MT</td>
</tr>
<tr>
<td>23.</td>
<td>*Frieling, Zach (Gerlach/Phillips)</td>
<td>M</td>
<td>Chem &amp; Bio Eng</td>
<td>Gallatin Gateway, MT</td>
</tr>
<tr>
<td>24.</td>
<td>Grodner, Ben (Wilking)</td>
<td>M</td>
<td>Chem &amp; Bio Eng</td>
<td>Mosier, OR</td>
</tr>
<tr>
<td>25.</td>
<td>*Gutknecht, Andrew (Peyton)</td>
<td>M</td>
<td>Chemistry &amp; Biochemistry</td>
<td>Buffalo, MN</td>
</tr>
<tr>
<td>26.</td>
<td>Haller, Gregory (Gerlach)</td>
<td>M</td>
<td>Chem &amp; Bio Eng</td>
<td>Lakewood, CO</td>
</tr>
<tr>
<td>27.</td>
<td>*Hobbs, Trace (Lauchnor/Gerlach)</td>
<td>M</td>
<td>Chemistry &amp; Biochemistry</td>
<td>Kalispell, MT</td>
</tr>
<tr>
<td>28.</td>
<td>*Hultin, Emily (Foreman)</td>
<td>F</td>
<td>Chem &amp; Bio Eng</td>
<td>Helena, MT</td>
</tr>
<tr>
<td>29.</td>
<td>Lee, Fei San (Goeres)</td>
<td>F</td>
<td>Chem &amp; Bio Eng</td>
<td>Malaysia</td>
</tr>
<tr>
<td>30.</td>
<td>Johnson, Spencer (Gerlach)</td>
<td>M</td>
<td>Chem &amp; Bio Eng</td>
<td>Boise, ID</td>
</tr>
<tr>
<td>32.</td>
<td>*Jones, Michael Steven (Phillips)</td>
<td>M</td>
<td>Civil &amp; Environ Eng</td>
<td>Ennis, MT</td>
</tr>
<tr>
<td>33.</td>
<td>Keepseagle, Kayla (Codd/Seymour)</td>
<td>F</td>
<td>Chem &amp; Bio Eng</td>
<td>Bismark, ND</td>
</tr>
<tr>
<td>34.</td>
<td>Kieffer, Whitney (Lauchnor)</td>
<td>M</td>
<td>Chem &amp; Bio Eng</td>
<td>Richland, WA</td>
</tr>
<tr>
<td>35.</td>
<td>Klingelsmith, Korinna (Fields)</td>
<td>F</td>
<td>Chem &amp; Bio Eng</td>
<td>Fort Collins, CO</td>
</tr>
<tr>
<td>36.</td>
<td>*Koc, Gunes (Peyton)</td>
<td>M</td>
<td>Chem &amp; Bio Eng</td>
<td>Turkey</td>
</tr>
<tr>
<td>37.</td>
<td>Massey, KaeLee (Fields)</td>
<td>F</td>
<td>Chem &amp; Bio Eng</td>
<td>Billings, MT</td>
</tr>
<tr>
<td>38.</td>
<td>*Meagher, Michelle (Peyton)</td>
<td>M</td>
<td>Chem &amp; Bio Eng</td>
<td>Idaho Falls, MT</td>
</tr>
<tr>
<td>39.</td>
<td>Moeun, Youra (Wilking)</td>
<td>F</td>
<td>Chem &amp; Bio Eng</td>
<td>Cambodia</td>
</tr>
<tr>
<td>40.</td>
<td>*Nuhoglu, Gulcin (Foreman)</td>
<td>F</td>
<td>Chem &amp; Bio Eng</td>
<td>Turkey</td>
</tr>
<tr>
<td>41.</td>
<td>*Oeschger, Taylor (Foreman)</td>
<td>F</td>
<td>Chem &amp; Bio Eng</td>
<td>Sacramento, CA</td>
</tr>
<tr>
<td>42.</td>
<td>*Oloff, Esther (Chang)</td>
<td>F</td>
<td>Chem &amp; Bio Eng</td>
<td>Idaho Falls, ID</td>
</tr>
<tr>
<td>43.</td>
<td>Olson, Caitlin (Fields)</td>
<td>F</td>
<td>Chem &amp; Bio Eng</td>
<td>Helena, MT</td>
</tr>
<tr>
<td>44.</td>
<td>Osborn, Alison (Fields)</td>
<td>F</td>
<td>Civil &amp; Environ Eng</td>
<td>Fort Collins, CO</td>
</tr>
<tr>
<td>45.</td>
<td>*Parson, Amanda (Codd/Seymour)</td>
<td>F</td>
<td>Chem &amp; Bio Eng</td>
<td>Acton, MT</td>
</tr>
<tr>
<td>46.</td>
<td>Parrett, Brian (James)</td>
<td>M</td>
<td>Microbiology &amp; Immunology</td>
<td>Rochester, NY</td>
</tr>
<tr>
<td>47.</td>
<td>Park, Rita (Phillips/Fields)</td>
<td>F</td>
<td>Microbiology &amp; Immunology</td>
<td>Butte, MT</td>
</tr>
<tr>
<td>48.</td>
<td>Peters, Daniel (Gerlach)</td>
<td>M</td>
<td>Chem &amp; Bio Eng</td>
<td>Butte, MT</td>
</tr>
<tr>
<td>49.</td>
<td>*Platt, George (Gerlach)</td>
<td>M</td>
<td>Chem &amp; Bio Eng</td>
<td>Big Timber, AK</td>
</tr>
<tr>
<td>50.</td>
<td>Polukoff, Natalya (Goeres)</td>
<td>F</td>
<td>Microbiology &amp; Immunology</td>
<td>Park City, UT</td>
</tr>
</tbody>
</table>
Undergraduates Summary: 2016–2017

<table>
<thead>
<tr>
<th>Department (Program)</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical &amp; Biological Engineering</td>
<td>21M</td>
<td>21F</td>
<td>42</td>
</tr>
<tr>
<td>Chemistry &amp; Biochemistry</td>
<td>2M</td>
<td>2F</td>
<td>4</td>
</tr>
<tr>
<td>Civil Engineering</td>
<td>3M</td>
<td>1F</td>
<td>4</td>
</tr>
<tr>
<td>Land Resources &amp; Environ Sci (LRES)</td>
<td>1M</td>
<td>1F</td>
<td>2</td>
</tr>
<tr>
<td>Mechanical &amp; Industrial Engineering</td>
<td>1M</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Microbiology &amp; Immunology</td>
<td>4M</td>
<td>4F</td>
<td>8</td>
</tr>
<tr>
<td>Modern Languages &amp; Literature</td>
<td>1M</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>33 M</strong></td>
<td><strong>29 F</strong></td>
<td><strong>62</strong></td>
</tr>
</tbody>
</table>
# EDUCATION:

## Graduate Students: Summer 2016, Fall 2016, Spring 2017

*Native American  *Received degree

### Masters Candidates

<table>
<thead>
<tr>
<th>#</th>
<th>Name</th>
<th>Gender</th>
<th>Program</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Berglund, Emily (Wilking)</em></td>
<td>F</td>
<td>Chem &amp; Bio Engineering</td>
<td>Helena, MT</td>
</tr>
<tr>
<td>2</td>
<td><em>Bernard, Garrett (Chang)</em></td>
<td>M</td>
<td>Material Sciences</td>
<td>Leitchfield, KY</td>
</tr>
<tr>
<td>3</td>
<td>Beser, Guneycon Dicle (Phillips)</td>
<td>F</td>
<td>Civil &amp; Environ Engineering</td>
<td>Turkey</td>
</tr>
<tr>
<td>4</td>
<td><em>Ertuna, Cagan (Peyton)</em></td>
<td>M</td>
<td>Chem &amp; Bio Engineering</td>
<td>Cyprus</td>
</tr>
<tr>
<td>5</td>
<td>LeFevre, Thomas (Wilking)</td>
<td>M</td>
<td>Chem &amp; Bio Engineering</td>
<td>Escanaba, MI</td>
</tr>
<tr>
<td>6</td>
<td>Nitzinger, Violeta (Eggers)</td>
<td>F</td>
<td>Health &amp; Human Develop</td>
<td>Livingston, MT</td>
</tr>
<tr>
<td>7</td>
<td>Morasko, Vincent (Gerlach/Phillips)</td>
<td>M</td>
<td>Chem &amp; Bio Engineering</td>
<td>Glendive, MT</td>
</tr>
<tr>
<td>8</td>
<td>Ozcan, Safiye Selen (Foreman)</td>
<td>F</td>
<td>Chem &amp; Bio Engineering</td>
<td>Turkey</td>
</tr>
<tr>
<td>9</td>
<td><em>Pelizzaro, Aline (Fields)</em></td>
<td>F</td>
<td>Microbiology &amp; Immunology</td>
<td>Brazil</td>
</tr>
<tr>
<td>10</td>
<td><em>Pedersen, Todd (Peyton)</em></td>
<td>M</td>
<td>Chem &amp; Bio Engineering</td>
<td>Poulsbo, WA</td>
</tr>
<tr>
<td>11</td>
<td>Raeside, Emma (Stein)</td>
<td>F</td>
<td>Civil &amp; Environ Engineering</td>
<td>Rochester, NY</td>
</tr>
<tr>
<td>12</td>
<td>Reichart, Nicholas (Hatzenpichler)</td>
<td>M</td>
<td>Microbiology &amp; Immunology</td>
<td>Bel Air, MD</td>
</tr>
<tr>
<td>13</td>
<td><em>Schaefer, Robert (Chang)</em></td>
<td>M</td>
<td>Chem &amp; Bio Engineering</td>
<td>Bothell, WA</td>
</tr>
<tr>
<td>14</td>
<td><em>Schott, Ralene (Eggers)</em></td>
<td>F</td>
<td>Nursing</td>
<td>Butte, MT</td>
</tr>
<tr>
<td>15</td>
<td>Silva, Esther (Eggers)</td>
<td>F</td>
<td>Nursing</td>
<td>Bozeman, MT</td>
</tr>
<tr>
<td>16</td>
<td>Stoick, Emily (Lauchnor)</td>
<td>F</td>
<td>Civil &amp; Environ Engineering</td>
<td>Kalispell, MT</td>
</tr>
<tr>
<td>17</td>
<td>Summers, Jennifer (Goeres)</td>
<td>F</td>
<td>Chem &amp; Bio Engineering</td>
<td>Conowingo, MD</td>
</tr>
<tr>
<td>18</td>
<td>Wallis, Jack (Stein)</td>
<td>M</td>
<td>Civil &amp; Environ Engineering</td>
<td>Vancouver, WA</td>
</tr>
<tr>
<td>19</td>
<td><em>White, Benjamin (Franklin)</em></td>
<td>M</td>
<td>Microbiology &amp; Immunology</td>
<td>Grand Island, NE</td>
</tr>
<tr>
<td>20</td>
<td>Woodhouse, Shayla (Stein)</td>
<td>F</td>
<td>Civil &amp; Environ Engineering</td>
<td>San Diego, CA</td>
</tr>
<tr>
<td>21</td>
<td><em>Yanardag, Sila (Franklin)</em></td>
<td>F</td>
<td>Microbiology &amp; Immunology</td>
<td>Turkey</td>
</tr>
</tbody>
</table>

### PhD Candidates

<table>
<thead>
<tr>
<th>#</th>
<th>Name</th>
<th>Gender</th>
<th>Program</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Abbasi, Reha (Wilking)</td>
<td>M</td>
<td>Chem &amp; Bio Engineering</td>
<td>Turkey</td>
</tr>
<tr>
<td>2</td>
<td>Akiyama, Tatsuya (Franklin)</td>
<td>M</td>
<td>Microbiology &amp; Immunology</td>
<td>Japan</td>
</tr>
<tr>
<td>3</td>
<td>Akyel, Arda (Gerlach)</td>
<td>M</td>
<td>Chem &amp; Bio Engineering</td>
<td>Turkey</td>
</tr>
<tr>
<td>4</td>
<td>Anjum, Sobia (Gerlach)</td>
<td>F</td>
<td>Civil &amp; Environ Engineering</td>
<td>Pakistan</td>
</tr>
<tr>
<td>5</td>
<td>Beck, Ashley (Carlson)</td>
<td>F</td>
<td>Microbiology &amp; Immunology</td>
<td>Corning, ID</td>
</tr>
<tr>
<td>6</td>
<td><em>Bell, Tisza (Fields/Peyton)</em></td>
<td>F</td>
<td>Microbiology &amp; Immunology</td>
<td>Littleton, CO</td>
</tr>
<tr>
<td>7</td>
<td>Brame, Keenan (Camper)</td>
<td>M</td>
<td>LRES</td>
<td>Livingston, MT</td>
</tr>
<tr>
<td>8</td>
<td>Camilleri, Laura (Fields)</td>
<td>F</td>
<td>Microbiology &amp; Immunology</td>
<td>Ukhia, CA</td>
</tr>
<tr>
<td>9</td>
<td>Corredor Arias, Luisa (Fields)</td>
<td>F</td>
<td>Microbiology &amp; Immunology</td>
<td>Colombia</td>
</tr>
<tr>
<td>10</td>
<td>Davis, Katherine (Gerlach/Fields)</td>
<td>F</td>
<td>Civil &amp; Environ Engineering</td>
<td>Green Creek, NC</td>
</tr>
<tr>
<td>11</td>
<td>Figgins, Devin (Chang)</td>
<td>M</td>
<td>Chem &amp; Bio Engineering</td>
<td>Kent, WA</td>
</tr>
<tr>
<td>12</td>
<td>Franco, Lauren (Fields)</td>
<td>F</td>
<td>Microbiology &amp; Immunology</td>
<td>Moorpark, CA</td>
</tr>
<tr>
<td>13</td>
<td><em>Hunt, Kristopher (Carlson)</em></td>
<td>M</td>
<td>Chem &amp; Bio Engineering</td>
<td>Thorp, WI</td>
</tr>
<tr>
<td>14</td>
<td>Jackson, Matthew (Gerlach)</td>
<td>M</td>
<td>Civil &amp; Environ Engineering</td>
<td>Naples, FL</td>
</tr>
<tr>
<td>15</td>
<td>Koenick, Hannah (Peyton)</td>
<td>F</td>
<td>Chem &amp; Bio Engineering</td>
<td>Sherman, TX</td>
</tr>
<tr>
<td>16</td>
<td><em>Kirkland, Catherine (Codd/Seymour)</em></td>
<td>F</td>
<td>Civil &amp; Environ Engineering</td>
<td>Bozeman, MT</td>
</tr>
<tr>
<td>17</td>
<td>Krantz, Gregory (Fields)</td>
<td>M</td>
<td>Microbiology &amp; Immunology</td>
<td>Tintonmouth, VT</td>
</tr>
<tr>
<td>18</td>
<td>Mery, Stephen (Lauchnor)</td>
<td>M</td>
<td>Civil &amp; Environ Eng</td>
<td>Danielsville, PA</td>
</tr>
<tr>
<td>19</td>
<td>McGill, Stacy (Carlson)</td>
<td>M</td>
<td>Microbiology &amp; Immunology</td>
<td>Minor Hill, TN</td>
</tr>
<tr>
<td>20</td>
<td>Moll, Karen (Peyton)</td>
<td>F</td>
<td>Microbiology &amp; Immunology</td>
<td>Fairport, NY</td>
</tr>
<tr>
<td>21</td>
<td>Rathore, Muneeb (Peyton)</td>
<td>M</td>
<td>Chem &amp; Bio Engineering</td>
<td>Pakistan</td>
</tr>
<tr>
<td>22</td>
<td>*Schoen, Heidi (Peyton)</td>
<td>F</td>
<td>Chem &amp; Bio Engineering</td>
<td>Geneva, NY</td>
</tr>
<tr>
<td>23</td>
<td>Schweitzer, Hannah (Fields)</td>
<td>F</td>
<td>Microbiology &amp; Immunology</td>
<td>Chester, MT</td>
</tr>
<tr>
<td>24</td>
<td>Sidar, Barkan (Wilking)</td>
<td>M</td>
<td>Chem &amp; Bio Engineering</td>
<td>Bozeman, MT</td>
</tr>
<tr>
<td>25</td>
<td>Simkins, Jeffrey (Stewart)</td>
<td>M</td>
<td>Chem &amp; Bio Engineering</td>
<td>Bozeman, MT</td>
</tr>
<tr>
<td>26</td>
<td>Smith, Pamela (Eggers)</td>
<td>F</td>
<td>Nursing</td>
<td>Butte, MT</td>
</tr>
<tr>
<td>27</td>
<td>Thuen, Adam (Chang)</td>
<td>M</td>
<td>Microbiology &amp; Immunology</td>
<td>Burlington, ND</td>
</tr>
<tr>
<td>28</td>
<td>Walsh, Danica (Stewart)</td>
<td>F</td>
<td>Chemistry &amp; Biochemistry</td>
<td>Olympia, WA</td>
</tr>
<tr>
<td>29</td>
<td>Zambare, Neerja (Gerlach)</td>
<td>F</td>
<td>Chem &amp; Bio Engineering</td>
<td>India</td>
</tr>
<tr>
<td>30</td>
<td>Zath, Geoffrey (Chang)</td>
<td>M</td>
<td>Chem &amp; Bio Engineering</td>
<td>Bend, OR</td>
</tr>
<tr>
<td>31</td>
<td>Zelaya, Anna (Fields)</td>
<td>F</td>
<td>Microbiology &amp; Immunology</td>
<td>Russellville, AK</td>
</tr>
</tbody>
</table>
**EDUCATION:**

**Graduate Students, 2016–2017**

### 19: Chemical & Biological Engineering

**MS: 8**

- 5 M Ertuna, Cagan: MS, Peyton
- LeFevre, Thomas: MS, Wilking
- Morasko, Vinny: MS, Gerlach/Phillips
- Pedersen, Todd: MS, Peyton
- Schaefer, Robert: MS, Chang

- 3 F Berglund, Emily: MS, Wilking
- Ozcan, Safiye Selen: MS, Foreman
- Summers, Jennifer: MS, Goeres

**PhD: 11**

- 8 M Abbasi, Reha: PhD, Wilking
- Akyel, Arda: PhD, Gerlach
- Figgins, Devin: PhD, Chang
- Hunt, Kristopher: PhD, Carlson
- Rathore, Muneeb: PhD, Peyton
- Sidar, Barkan: PhD, Wilking
- Simkins, Jeffrey: PhD, Stewart
- Zath, Geoffrey: PhD, Chang

- 3 F Koepnick, Hannah: PhD, Peyton
- Schoen, Heidi: PhD, Peyton/Carlson
- Zambare, Neerja: PhD, Gerlach

### 1: Chemistry & Biochemistry

**PhD: 1**

- 1 F Walsh, Danica: PhD, Stewart

### 10: Civil / Environmental Engineering

**MS: 5**

- 1 M Wallis, Jack: MS, Stein

- 4 F Beser, Gunecon Dicle: MS, Phillips
- Raeside, Emma: MS, Stein
- Stoick, Emily: MS, Lauchnor
- Woodhouse, Shayla: MS, Stein

**PhD: 5**

- 2 M Mery, Stephen: PhD, Lauchnor
- Jackson, Matthew: PhD, Gerlach

- 3 F Anjum, Sobia: PhD, Gerlach
- Davis, Katie: PhD, Gerlach/Fields
- Kirkland, Catherine: PhD, Codd

### 1: Health & Human Development

**MS: 1**

- 1 F Nitzinger, Violeta: MS, Eggers

### 1: Land Resources & Environmental Sciences

**PhD: 1**

- 1 M Brame, Keenan: PhD, Camper

### 1: Material Sciences

**MS: 1**

- 1 M Bernard, Garrett: MS, Chang

### 16: Microbiology

**MS: 1**

- 2 F Pelizzaro, Aline: MS, Fields
- Yanardag, Sila: MS, Franklin

**PhD: 10**

- 4 M Akiyama, Tatsuya: PhD, Franklin
- Krantz, Gregory: PhD, Fields
- McGill, Stacy: PhD, Carlson
- Thuen, Adam: PhD, Chang

- 8 F Beck, Ashley: PhD, Carlson
- Bell, Tisza: PhD, Fields/Peyton
- Camilleri, Laura: PhD, Fields
- Corredor Arias, Luisa: PhD, Fields
- Franco, Lauren: PhD, Fields
- Moll, Karen: PhD, Peyton
- Schweitzer, Hannah: PhD, Fields
- Zelaya, Anna: PhD, Fields

### 3: Nursing

**MS: 2**

- 2 F Schott, Ralene: MS, Eggers
- Silva, Esther: MS, Eggers

**PhD: 1**

- 1 F Smith, Pamela: PhD, Eggers

**TOTALS**

<table>
<thead>
<tr>
<th>Total Grads: 52</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total MS: 21</td>
</tr>
<tr>
<td>9 M / 12 F</td>
</tr>
<tr>
<td>Total PhD: 31</td>
</tr>
<tr>
<td>15 M / 16 F</td>
</tr>
</tbody>
</table>

Total Male: 24
Total Female: 28
EDUCATION:

**Graduating with advanced degrees: June 2016–June 2017**

*Kylie Bodle, MS, Civil Engineering, July 2016*
Effects of Triclosan exposure on nitrification in activated sludge, biofilms, and pure cultures of nitrifying bacteria

*Todd Pedersen, MS, Chemical and Biological Engineering, August 2016*
Use of bicarbonate salts in algal growth for enhancement of lipid content

*Kristopher Hunt, PhD, Chemical and Biological Engineering, September 2016*
Multiscale analysis of trophic interactions in microbial communities

*Ben White, MS, Microbiology & Immunology, October 2016*
*Pseudomonas aeruginosa biofilms in an in vitro chronic wound model*

*Tisza Bell, PhD, Microbiology & Immunology, November 2016*
Exploring complex systems and relationships in the quest for renewable algal biodiesel

*Garret Bernhard, MS, Materials Science, December 2016*
Non-thesis master’s degree

*Heidi Schoen, PhD, Chemical and Biological Engineering, January 2017*
Fungal production of biofuel and flavor compounds in liquid and solid state

*Emily Berglund, MS, Chemical and Biological Engineering, April 2017*
Breaking up isn’t hard to do: Crystal pressure in nanoscale pores

*Catherine Kirkland, PhD, Civil Engineering, May 2017*
Nuclear magnetic resonance studies of biofilm–porous media systems

*Sila Yanardag, MS, Microbiology & Immunology, June 2017*
Characterization of the stability of the *Pseudomonas aeruginosa* ribosomal proteins under stress conditions
EDUCATION:

2017 MSU Student Research Celebration: CBE Participants

MSU’s undergraduate and graduate students shared their research at the annual Student Research Celebration Friday, April 21, 2017. Among the more than 200 students presenting their research, numerous students were connected with the Center for Biofilm Engineering.

POSTERS

Graduate Students

Kevin Burt: Civil Engineering
Mentor: Ellen Lauchnor, Neerja Zambare -- Civil Engineering, Center for Biofilm Engineering
“Calcium precipitation and trace metal co-precipitation during fluid flow and mixing”

Geoffrey Zath: Chemical & Biological Engineering
Mentor: Connie Chang -- Chemical & Biological Engineering, Center for Biofilm Engineering
“A high-throughput, multiplexed microfluidic method utilizing an optically barcoded drop library”

Undergraduate Students

Lydia Aman: Chemical & Biological Engineering
Mentor: Ellen Lauchnor -- Civil Engineering, Center for Biofilm Engineering
“Quantifying ammonia oxidation kinetics of Nitrosomonas europaea with competitive inhibition”

Taylor Blossom: Chemical & Biological Engineering
Mentor: Ross Carlson -- Chemical & Biological Engineering, Center for Biofilm Engineering
“Bio-fuel production by community biofilm”

Jacob Carter-Gibb: Civil Engineering
Mentor: Connie Chang -- Chemical & Biological Engineering, Center for Biofilm Engineering
“Microfluidic particles as a tool for monitoring oxygen levels in biofilms in magnetic resonance microscopy”

Lauren Dupuis: Chemistry & Biochemistry
Mentor: Connie Chang, Sharon Neufeldt -- Center for Biofilm Engineering, Chemistry & Biochemistry
“Krytox-PEG triblock copolymer surfactant synthesis and modification” *Awarded INBRE Top Poster

Zachary Frieling: Chemical & Biological Engineering
Mentor: Robin Gerlach -- Chemical & Biological Engineering, Center for Biofilm Engineering
“Urease inhibition, transport, and distribution to better understand its subsurface behavior”

Kayla Keepseagle: Chemical & Biological Engineering
Mentor: Joseph Seymour -- Chemical & Biological Engineering, Center for Biofilm Engineering
“Learning engineering through research on multidisciplinary topics”

Whitney Kieffer: Chemical & Biological Engineering
Mentor: Ellen Lauchnor -- Civil Engineering, Center for Biofilm Engineering
“Sorption of contaminants in treatment wetlands”

Youra Moeun: Chemical & Biological Engineering
Mentor: James Wilking -- Center for Biofilm Engineering
“Quantifying pharmaceutical composite breakup using acoustic methods”

Esther Oloff: Chemical & Biological Engineering
Mentor: Connie Chang -- Chemical & Biological Engineering, Center for Biofilm Engineering
“Microfluidic techniques for encapsulating gastric organoids”

Caitlin Olson: Chemical & Biological Engineering
Mentor: Matthew Fields -- Microbiology & Immunology, Center for Biofilm Engineering
“Linking microbial biofilms to nitrate removal in groundwater sediments”

Madison Owens: Chemical & Biological Engineering
Mentor: James Wilking -- Chemical & Biological Engineering, Center for Biofilm Engineering
“Developing a biocompatible formulation for stereolithographic 3D printing”

Daniel Peters: Chemical & Biological Engineering
Mentor: Robin Gerlach -- Chemical & Biological Engineering, Center for Biofilm Engineering
“Characterizing algae growth and biomass composition under autotrophic, mixotrophic and heterotrophic conditions”

George Platt: Chemical & Biological Engineering
Mentor: Robin Gerlach -- Chemical & Biological Engineering, Center for Biofilm Engineering
“Attempting to identify the sources of microbial methane production from coal”
Shawna Pratt: Chemical & Biological Engineering  
Mentor: Connie Chang – Chemical & Biological Engineering, Center for Biofilm Engineering  
"Monitoring single-cell bacterial growth using drop-based microfluidics"  
*Awarded INBRE Top Poster

Rita Park: Microbiology & Immunology  
Mentor: Margaux Mesle, Adrienne Phillips, Matthew Fields – Center for Biofilm Engineering  
“Effect of coal particle size on microbial methanogenesis in the presence of oxygen”

Bronwyn Stockton: Biotechnology  
Mentor: Matthew Fields – Center for Biofilm Engineering  
“Carbon utilization in an anaerobic interdomain consortium”

EDUCATION:

News highlights

**National Science Foundation-Graduate Research Fellowship (NSF-GRFP)**

Isaac Miller, CBE research technician, received a prestigious NSF Graduate Research Fellowship to study fish and algae. Miller received his undergraduate degree in ecology from MSU and for two years worked at the Bozeman Fish Technology Center. With this fellowship, Miller will continue his work on investigating the bacteria, viruses and other microorganisms that live inside the gastrointestinal tracts of fish. According to Miller, learning more about the complex microbial communities that live in fish, the fish microbiome as it’s called, can help scientists understand how fish digest food and use their nutrients. That knowledge can help in the management of fish nutrition and growth, lead to the discovery of unique natural products, and provide basic knowledge that lays the foundation for future research projects applied to water and food needs for society.

This NSF program recognizes and supports outstanding graduate students in NSF-supported science, technology, engineering, and mathematics disciplines who are pursuing research-based masters and doctoral degrees at accredited US institutions.

Read more about Miller and his research at MSU News: [“MSU researcher receives NSF Graduate Research Fellowship to study fish and algae”](MSU researcher receives NSF Graduate Research Fellowship to study fish and algae)

**CBE undergrads present research at national conference**

Five MSU-CBE undergraduate students presented their research at the 31st annual National Conferences on Undergraduate Research held in April at the University of Memphis in Tennessee. Brooke Filanoski, Emily Hultin, Taylor Oeschger, Rita Park, and Hanna Showers were among 13 MSU students who traveled to Tennessee to present their work. To read about their research and the conference, go to MSU News: [“MSU students present projects at national conference that promotes undergraduate research.”](MSU students present projects at national conference that promotes undergraduate research.)

**CBE masters student earned Judges Prize at Three-Minute Thesis event**

Drew Norton, MSU master’s student in civil engineering, earned the Judges Prize for his presentation “Reducing leaky well emissions by growing biocement seals,” during the 3-Minute Thesis event on MSU’s campus.

For a third straight year a group of graduate students from Montana State University gave the public a chance to hear an 80,000-word thesis distilled into 180 seconds. MSU hosted the Three-Minute Thesis event on March 3rd at the Procrastinator Theater in the Strand Union Building.

The seven finalists chosen for the 3-Minute Thesis competition are from disciplines across MSU’s College of Engineering. The finalists explained, very concisely, how their research might affect the public. Presenters were required to condense their research into a brief, engaging presentation for a non-specialist audience, using a single presentation slide.

In three minutes, Norton was able to successfully explain how the application of *Sporosarcina pasteurii*, a mineral-producing bacteria, can stop tiny, hard-to-reach leaks in underground oil and gas wells and potentially prevent harmful
gases, like methane, from migrating to the surface and becoming airborne.

For a complete list of the finalists, go to MSU News Service: “Three minute thesis event set for March 3 at MSU”

**College of Engineering Awards**

**Neerja Zambare**, MSU-CBE PhD student in chemical and biological engineering, was honored with the **Raymond E. and Erin S. Schultz Emerging Fellowship Award** for the 2016–2017 academic year. The award is given to graduate students in MSU’s Department of Chemical and Biological Engineering in recognition of high academic performance in coursework and grades, and history of receiving awards, grants, and scholarships. The award also recognizes research accomplishments evidenced by publications and presentations.

Zambare earned her bachelor’s degree in chemical and biological engineering from Montana State University. She is now pursuing her doctorate degree at MSU studying the effects of reaction and transport of microbially induced calcium carbonate precipitation (MICP). MICP has been proven as an application to seal cracks in oil and gas wells. Zambare’s adviser is **Robin Gerlach**, CBE-affiliated faculty in chemical and biological engineering.

**2017 W.G. Characklis Outstanding Student Award**

The CBE presented the 2017 W.G. Characklis Outstanding Student Award to Catherine “Cat” Kirkland. Cat received the award in recognition of the intellectual curiosity and creativity that she brings to her interdisciplinary research project, the quality and productivity of her research including three first-author publications, her participation in service programs such as Engineers Without Borders and Shadow an Engineer Day, and her leadership in creating the Graduate Student Seminar Series and the Three Minute Thesis Competition.

The W.G. Characklis Award is presented annually to CBE doctoral students for their contributions to research and education. The award honors Center Founder Bill Characklis, who envisioned students working in interdisciplinary teams, participating in innovative educational programs, interacting with industry, and assuming leadership roles.

**2017 CBE Student Citizen Award**

**Lauren Franco**, PhD candidate in microbiology and immunology, received the 2017 CBE Student Citizen award. Lauren can be counted on to be kind and generous with her time and knowledge, but takes her responsibilities very seriously. She is a model of thoroughness and always shows respect for safety, equipment, training and her colleagues—qualities John Neuman strived to instill in students. Lauren also exemplifies the CBE culture of fellowship and togetherness outside the lab with her efforts organizing CBE TGIF events.

The Student Lab Citizen Award is open to any CBE student and recognizes a student’s exceptional responsibility and good citizenship in his or her work at the CBE. Attributes that are considered in selecting awardees include: attention to laboratory safety and cleanliness, considerate use of shared spaces, respect for equipment and proper protocols, willingness to help fellow students and staff, strong work ethic, and commitment to CBE goals. The award is presented in honor of John Neuman, the CBE’s Technical Operations Manager from 1994–2008 and was established by John’s family after his death in 2011.
# CBE Seminar Series: Fall 2016

**Montana State University, Roberts Hall 101, 4:10pm**

<table>
<thead>
<tr>
<th>Date</th>
<th>Speaker</th>
<th>Affiliation</th>
<th>Title/Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sep 1</td>
<td>No Seminar—First Week of Classes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sep 8</td>
<td>Dr. Roland Hatzenpichler</td>
<td>Assistant Research Professor, Dept. of Microbiology &amp; Immunology, MSU, CBE</td>
<td>Community dynamics and new cell-cell interactions of slow-growing archaeal-bacterial consortia from deep-sea methane seeps</td>
</tr>
<tr>
<td>Sep 15</td>
<td>Dr. Patricia Brennan</td>
<td>Visiting Professor, Dept. of Biological Sciences, Mount Holyoke College, South Hadley, MA</td>
<td>Time to step up in defense of science</td>
</tr>
<tr>
<td>Sep 22</td>
<td>No Seminar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sep 29</td>
<td>Dr. Chiachi Hwang</td>
<td>Industrial Research Scientist, CBE</td>
<td>Evaluation of Se reduction in saturated rocks backfills</td>
</tr>
<tr>
<td>Oct 6</td>
<td>Dr. Mike Franklin</td>
<td>Professor, Dept. of Microbiology &amp; Immunology, MSU, CBE</td>
<td>Heterogeneity and dormancy in microbial biofilms</td>
</tr>
<tr>
<td>Oct 13</td>
<td>Dr. Megan Bergkessel</td>
<td>Post-Doctoral Fellow, Geobiology &amp; Biological Engineering, California Institute of Technology, Pasadena, CA</td>
<td>Regulation of gene expression during slow growth in <em>Pseudomonas aeruginosa</em></td>
</tr>
<tr>
<td>Oct 20</td>
<td>Dr. Marnie Feder, Arda Akyel</td>
<td>Post-Doctoral Research Associate, CBE, MS Student, Dept. of Chemical &amp; Biological Engineering, MSU, CBE</td>
<td>Investigating the kinetics and stability of eukaryotic and prokaryotic ureases for use in engineered applications</td>
</tr>
<tr>
<td>Oct 27</td>
<td>Gregory Krantz</td>
<td>Ph.D. Candidate, Dept. of Microbiology &amp; Immunology, MSU, CBE</td>
<td>Bulk phase resource ratio alters electron transfer mechanisms in sulfate-reducing biofilms grown on metal</td>
</tr>
<tr>
<td>Nov 3</td>
<td>Dr. J. Andrés Christen</td>
<td>Investigador Titular “B”, CIMAT, Guanajuato, Mexico</td>
<td>Bayesian statistics for scientific experiments: more kick for your experimental effort!</td>
</tr>
<tr>
<td>Nov 10</td>
<td>Dr. Patricia Tavormina</td>
<td>Associate Research Scientist, Geobiological &amp; Planetary Sciences, California Institute of Technology, Pasadena, CA</td>
<td>A diverse assemblage of bacteria with atypical alkane oxidizing potential responded to the Porter Ranch gas leak</td>
</tr>
<tr>
<td>Nov 17</td>
<td>Dr. Dana Skorupa</td>
<td>Post-Doctoral Research Associate, CBE</td>
<td>A tale of two extremophiles: Enrichment of haloalkaliphilic biomineralizing bacteria &amp; discovery of novel thermoalkaliphilic archaea</td>
</tr>
<tr>
<td>Nov 24</td>
<td>No Seminar—Thanksgiving Day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dec 1</td>
<td>Dr. Matthew Stott</td>
<td>Leader, Extremophiles Research Group at GNS Science, Taupō, New Zealand</td>
<td>The phenotypic, genomic and ecological characterisation of a candidate phylum OP10 representative: A cautionary tale</td>
</tr>
<tr>
<td>Dec 8</td>
<td>No Seminar—Last Week of Classes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## EDUCATION:

**CBE Seminar Series: Spring 2017**

**Montana State University, Roberts Hall 321, 4:10pm**

<table>
<thead>
<tr>
<th>Date</th>
<th>Speaker</th>
<th>Affiliation</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan 12</td>
<td>No seminar—First week of classes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jan 19</td>
<td>No Seminar – CBE semi-annual rally</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jan 23</td>
<td>Dr. Arwyn Edwards</td>
<td>Senior Lecturer, Biology, University of Wales, Aberystwyth, Wales</td>
<td>Exploring the microbial frontiers of our melting planet</td>
</tr>
<tr>
<td>Jan 26</td>
<td>Dr. Thomas Webster</td>
<td>Professor, Chair of the Department of Chemical Engineering, Northeastern University, Boston, Massachusetts</td>
<td>Nanotechnology for the control of bacterial functions</td>
</tr>
<tr>
<td>Feb 2</td>
<td>Dr. Qian Wang</td>
<td>Postdoctoral Visiting Scholar, Environmental Microbiology, MSU</td>
<td>Methylphosphonate metabolism contributes to the methane oversaturation paradox inoxic freshwater lakes</td>
</tr>
<tr>
<td>Feb 9</td>
<td>Dr. Seth Walk</td>
<td>Assistant Professor, Microbiology &amp; Immunology, MSU</td>
<td>Engineered human intestinal organoids and arsenic detox by the human microbiome</td>
</tr>
<tr>
<td>Feb 16</td>
<td>Dr. Suzanne Ishaq</td>
<td>Postdoctoral Researcher, Land Resources and Environmental Sciences, MSU</td>
<td>Mapping the microbial development of the dairy calf digestive tract</td>
</tr>
<tr>
<td>Mar 9</td>
<td>Racheal Upton</td>
<td>PhD Candidate, Ecology, Evolution, Organismal Biology, Iowa State University, Ames, Iowa</td>
<td>A scaling approach to determine the drivers of complex soil microbial communities</td>
</tr>
<tr>
<td>Mar 15</td>
<td>No Seminar – Spring Break</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mar 23</td>
<td>Dr. Blake Wiedenheft</td>
<td>Assistant Professor, Microbiology &amp; Immunology, MSU</td>
<td>Bacteria, their viruses, and how they taught us to perform genome surgery</td>
</tr>
<tr>
<td>Mar 30</td>
<td>Joy Buongiorno</td>
<td>PhD Candidate, Microbiology, University of Tennessee, Knoxville, Tennessee</td>
<td>High-resolution microbial community abundance and composition analysis of two iron-rich fjords, Kongsfjorden and Van Keulenfjorden, Svalbard (79degN): implications for climate response</td>
</tr>
<tr>
<td>Apr 6</td>
<td>Undergraduate Research Day</td>
<td>Madison Owens, Chemical &amp; Biological Engineering, MSU, CBE</td>
<td>Structuring synthetic biofilms with 3D printing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Andrew Gutknecht, Chemistry &amp; Biochemistry, MSU, CBE</td>
<td>Culturing thermoalkaiphilic <em>Aigarchaeota</em> from terrestrial geothermal environments</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shawna Pratt, Chemical &amp; Biological Engineering, MSU, CBE</td>
<td>Monitoring single bacterial cell growth using drop-based microfluidics</td>
</tr>
<tr>
<td>Apr 13</td>
<td>Dr. Andreas Teske</td>
<td>Professor, Marine Sciences, University of North Carolina, Chapel Hill, North Carolina</td>
<td>Sulfur-oxidizing bacterial mats in Guaymas Basin: dancing on the volcano</td>
</tr>
<tr>
<td>Apr 20</td>
<td>Dr. Sharon Neufeldt</td>
<td>Assistant Professor, Chemistry &amp; Biochemistry, MSU</td>
<td>Designing a catalytic system to convert methane into heavier alkanes</td>
</tr>
<tr>
<td>Apr 27</td>
<td>Dr. Annelise Barron</td>
<td>W.M. Keck Associate Professor, Bioengineering, Stanford University, Stanford, California</td>
<td>Antibiofilm activities of peptoid mimics of antimicrobial peptides (ampetoids)</td>
</tr>
<tr>
<td>May 4</td>
<td>No Seminar – Finals Week</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TECHNOLOGY TRANSFER:

**Industrial Associates, 2016–17**

Bold denotes new member
*Small denotes business member

3M
Accuratus Lab Services*
Acelity, formerly KCI
American Chemet*
BASF
Baxter Healthcare
Church & Dwight Company
CleanSpot, Inc. *
DeLaval
Dow Microbial Control
Ecolab
ICU Medical, Inc.
Lonza
Masco Corporation
NASA
NCH Corporation
Next Science
PPG Industries
Procter & Gamble Company
S.C. Johnson & Son, Inc.
SANUWAVE Health*
Sharklet Technologies, Inc.*
Smith & Nephew
Solvay
Sterilex*
STERIS
The Sherwin-Williams Company
W.L. Gore & Associates
Zimmer Biomet
TECHNOLOGY TRANSFER: Montana Biofilm Meeting
July 18–21, 2016

Monday, July 18
6:00–8:30 pm
Registration & welcome reception
Larkspur Foyer, Hilton Garden Inn
Bozeman

Tuesday, July 19
7:30–8:00 am
Registration & continental breakfast
Larkspur Foyer, Hilton Garden Inn

8:00–8:10
Introductory remarks
Larkspur Ballroom
Paul Sturman, CBE Industrial Coordinator
Matthew Fields, CBE Director
Chuck Pettigrew, Chair, CBE
Industrial Associates Program; Principal Scientist, Procter & Gamble

SESSION 1: Fungal Biofilms

8:10–8:20
Session introduction
Paul Sturman

8:20–8:50
A reproducible protocol for growing relevant filamentous fungal biofilms for industrial consumer product applications
Julia Kerrigan, Associate Professor, Mycology, Clemson University, Clemson, SC

8:50–9:20
Relevance of fungal biofilms: An industrial perspective
Tony Rook, Senior Manager, Microbiology Resource Center, The Sherwin-Williams Company, Cleveland, OH

9:20–9:50
A review of lab protocols for fungal biofilm studies and our path forward
Diane Walker, Research Engineer, CBE

9:50–10:20
Networking Break

10:20–10:50
Effect of selenite on the morphology and respiratory activity of Phanerochaete chrysosporium biofilms
Erika Espinosa-Ortiz, Postdoctoral Research Associate, CBE

10:50–11:20
Volatile organic compounds of a filamentous fungal mat at varying oxygen conditions
Heidi Schoen, PhD candidate, Chemical & Biological Engineering, MSU, CBE

11:20–11:50
Candida and Malassezia yeasts in biofilms
Garth James, Associate Research Professor, Chemical & Biological Engineering, MSU; Manager, Medical Biofilms Laboratory, CBE

12:00–1:00
Catered lunch, Hilton Garden Inn

SESSION 2: Industrial Biofilms

1:00–1:05
Session introduction
Paul Sturman

1:05–1:35
Copper: An effective antimicrobial?
Colin Anderson, R&D Director, American Chemet, E. Helena, MT

1:35–2:00
Integrated molecular, physiological, and in silico characterization of two extremophilic Halomonas isolates
Ross Carlson, Professor, Chemical & Biological Engineering, MSU, CBE
Chuck Pettigrew

2:00–2:25
Acoustic pressure shock wave technology successfully disrupts medical and non-medical biofilms
Iulian Cioanta, Vice President, R&D, SANUWAVE Health, Inc. Alpharetta, GA

CBE Open House: Lab demonstrations and poster session
2:45–4:45
3rd Floor EPS Building, MSU

Wednesday, July 20
7:30–8:00 am
Registration & continental breakfast
Larkspur Foyer, Hilton Garden Inn

SESSION 3: Biofilm Methods

8:00–8:40
Methods to assess biofilm prevention on surface modified urinary catheters
Darla Goeres, Associate Research Professor, Chemical & Biological Engineering, MSU; Manager, Standardized Biofilm Methods Laboratory, CBE

8:40–9:10
EPA Regulatory Update: Use of the Single Tube Method to support biofilm claims for antimicrobial products
Rebecca Pines, Biologist, Microbiology Laboratory Branch, Office of Pesticide Programs (OPP), US EPA, Fort Meade, MD
9:10–9:40
Using statistical confidence and power to assess performance standards for biofilm claims using the Single Tube Method
Al Parker, Assistant Research Professor, Mathematical Sciences, MSU; Bio-statistician, CBE

9:40–10:10 Networking Break

10:10–10:40
Quantifying biofilm development and structure with image analysis and high-resolution 3D imaging
Curtis Larimer, Postdoctoral Fellow, Pacific Northwest National Laboratory, Richland, WA

10:40–11:10
Osmotic pressure-induced rupturing of gastrointestinal organoids
Jim Wilking, Assistant Professor, Chemical & Biological Engineering, MSU, CBE

11:10–11:40
Montana Nanotechnology Facility: A powerful resource for biofilm science and engineering
David Dickensheets, Professor, Electrical & Computer Engineering; Director, Montana Nanotechnology Facility (MONT), MSU

11:40–12:00
State of the CBE

12:00–12:15
Presentation of CBE awards
Matthew Fields

12:15–1:15
Catered lunch, Hilton Garden Inn

1:20–1:50
The ecology of nitrification in water systems: A consortium of organisms and metabolisms
Anne Camper

1:50–2:20
Forced cooperation leads to improved productivity in a multispecies biofilm
Laura Camilleri, PhD student, Microbiology & Immunology, MSU, CBE

2:20–2:50
Biofilms enhance survival in extreme environments
Heidi Smith, Postdoctoral Researcher, CBE

2:50–3:20
Effects of chlorhexidine treatments on single and mixed species biofilms of Streptococcus mutans and Lactobacillus acidophilus as well as S. mutans and Actinomyces naeslundii
Rosa Oliveira, Postdoctoral Res., Araraquara School of Dentistry, UNESP–Univ. Estadual Paulista, Araraquara, São Paulo, Brazil

3:20–3:30 Break

3:30–5:00
Business Meeting
Hilton Garden Inn

6:00 Dinner/Banquet
Rockin’ TJ Ranch, Bozeman

Thursday, July 21

7:30–8:00 am
Registration & continental breakfast
Larkspur Foyer, Hilton Garden Inn

SESSION 4:
Multi-Species Biofilms
1:15–1:20
Session introduction
Anne Camper, Regents Professor, Civil Engineering, Associate Dean, College of Engineering, MSU, CBE

SESSION 5:
Wound Biofilms
8:00–8:05
Session Introduction
Garth James

8:05–8:40
Biofilm-related oxygen consumption in wounds
Garth James

8:40–9:10
Chronic wounds in diabetic patients: Biochemical association between skin microbiome and metabolic landscape
Mary Cloud Ammons, Assistant Research Professor, Chem. & Biochemistry, MSU

9:10–9:40
Predictive multiscale modeling of microbial biofilm consortia
Ross Carlson

9:40–10:10
Bacterial fitness determinants in chronic wound infections: Correlation with in vitro biofilm fitness
Sarah Morgan, Sr. Postdoctoral Fellow, Microbiology, University of Washington, Seattle, WA

10:10–10:40 Networking Break

SESSION 6:
Device-Related Biofilms
10:40–10:45
Session Introduction
Garth James

10:45–11:15
Understanding E. coli biofilms on urinary catheters: Are there CAUTI-specific characteristics?
Maria Hadjifrangiskou, Assistant Professor, Pathology, Microbiology, & Immunology, School of Medicine, Vanderbilt University, Nashville, TN

11:15–12:15
Strategies to treat intracellular and biofilm forming Staphylococcus aureus in orthopedic infections
Devendra Dusane, Postdoctoral Researcher, Microbial Infection & Immunity, The Ohio State University, Columbus, OH

12:15–12:25 Meeting Wrap-up

Back to Table of Contents
WORKSHOP:
The Scale of Biofilms Studies
July 18, 2016

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00 – 9:15</td>
<td>Welcome</td>
<td>EPS 323</td>
</tr>
<tr>
<td>9:15 – 9:30</td>
<td>The Scale of Biofilms – Paul Sturman</td>
<td>EPS 323</td>
</tr>
<tr>
<td>9:30 – 10:15</td>
<td>Big to Small – Muneeb Rathore, Darla Goeres, Connie Chang</td>
<td>EPS 323</td>
</tr>
<tr>
<td>10:30 – 10:40</td>
<td>Morning Refreshments</td>
<td>EPS 323</td>
</tr>
</tbody>
</table>

Morning Laboratory Rotations:

<table>
<thead>
<tr>
<th>Time</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:40 – 11:05</td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>11:05 – 11:30</td>
<td>B</td>
<td>C</td>
<td>A</td>
</tr>
<tr>
<td>11:30 – 11:55</td>
<td>C</td>
<td>A</td>
<td>B</td>
</tr>
</tbody>
</table>

A. Algal Biofilms – Muneeb Rathore
B. Microfluidic Cell Sorting – Geoffrey Zath
C. Standard Methods – Kelli Buckingham Meyer, Lindsey Lorenz, Jen Summers

12:00 - 1:00  LUNCH  SUB Ballroom B

1:00 - 2:00  Introduction to the Montana Nanotechnology Facility (MONT)
– David Dickensheets, Betsey Pitts, Recep Avci

2:15 - 2:30  Afternoon Refreshments

Afternoon Laboratory Rotations:

<table>
<thead>
<tr>
<th>Time</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>2:15 – 3:00</td>
<td>D</td>
<td>E</td>
<td>F</td>
</tr>
<tr>
<td>3:00 – 3:45</td>
<td>E</td>
<td>F</td>
<td>D</td>
</tr>
<tr>
<td>3:45 – 4:30</td>
<td>F</td>
<td>D</td>
<td>E</td>
</tr>
</tbody>
</table>

MONT Facility Tours:

A. ICAL Facility – Recep Avci
B. CBE Microscope Facility – Betsey Pitts
C. Microfabrication Facility – David Dickensheets

4:30 – 5:00  Wrap-Up/Discussion – All instructors

Appendix ToC
### TECHNOLOGY TRANSFER:
**Anti-Biofilm Technologies: Pathways to Product Development**  
**February 1, 2017**  
**Arlington, VA**

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:15 a.m.–8:00 a.m.</td>
<td>Registration and continental breakfast, Virginia Foyer, Plaza Level</td>
<td>Matthew Fields, Director, CBE; Paul Sturman, Industrial Coord., CBE; Leti Vega, International Scientist, Human Research Program, NASA; Chair, Industrial Associates Program, CBE</td>
</tr>
<tr>
<td>8:00 a.m.–8:10 a.m.</td>
<td>Welcome and opening remarks, Madison Ballroom</td>
<td>Matthew Fields, Director, CBE; Paul Sturman, Industrial Coord., CBE; Leti Vega, International Scientist, Human Research Program, NASA; Chair, Industrial Associates Program, CBE</td>
</tr>
<tr>
<td>8:10 a.m.–8:15 a.m.</td>
<td><strong>SESSION 1: Medical Device Technologies</strong> Session Introduction</td>
<td></td>
</tr>
<tr>
<td>8:15 a.m.–8:45 a.m.</td>
<td>An extraction free assay for quantifying residual protein and microbial biofilms on working surfaces</td>
<td>Allan Guan, ORISE Research Fellow, Office of Science &amp; Eng. Labs, Ctr. for Devices &amp; Radiological Health, FDA</td>
</tr>
<tr>
<td>8:45 a.m.–9:15 a.m.</td>
<td>Testing to support safety and effectiveness for medical devices containing antimicrobials</td>
<td>Brandon Kitchel, Microbiologist/Lead Reviewer, Office of Device Evaluation, Ctr. for Devices &amp; Radiological Health, FDA</td>
</tr>
<tr>
<td>9:15 a.m.–9:45 a.m.</td>
<td>Antibiotic resistance in biofilms: A review</td>
<td>Garth James, Associate Research Professor, Chemical &amp; Biological Engineering, MSU; CBE</td>
</tr>
<tr>
<td>9:45 a.m.–10:15 a.m.</td>
<td><strong>BREAK</strong></td>
<td></td>
</tr>
<tr>
<td>10:15 a.m.–10:45 a.m.</td>
<td>Multimodal preclinical imaging in infectious disease research</td>
<td>Kevin Francis, Preclinical Imaging Fellow, PerkinElmer</td>
</tr>
<tr>
<td>10:45 a.m.–11:15 a.m.</td>
<td>Infected megaprostheses: How patients drive science that may help patients</td>
<td>Nicholas Bernthal, MD, Department of Orthopaedic Surgery, UCLA</td>
</tr>
<tr>
<td>11:15 a.m.–12:00 p.m.</td>
<td>Session 1 wrap up and panel discussion</td>
<td></td>
</tr>
<tr>
<td>12:00 p.m.–1:00 p.m.</td>
<td>Networking Lunch, Adams</td>
<td></td>
</tr>
<tr>
<td>1:00 p.m.–1:10 p.m.</td>
<td><strong>SESSION 2: Surface Disinfection Technologies</strong> Session Introduction</td>
<td></td>
</tr>
<tr>
<td>1:10 p.m.–1:40 p.m.</td>
<td>Evaluating antimicrobial agents against biofilms</td>
<td>Phil Stewart, Professor, Chemical and Biological Engineering, MSU, CBE</td>
</tr>
<tr>
<td>1:40 p.m.–2:00 p.m.</td>
<td>Laboratory attributes of a low-level biofilm claim</td>
<td>Darla Goeres, Associate Research Professor, Chemical &amp; Biological Engineering, MSU, CBE</td>
</tr>
<tr>
<td>2:00 p.m.–2:20 p.m.</td>
<td>Changes in a method’s variability when used for low-level claims</td>
<td>Darla Goeres</td>
</tr>
<tr>
<td>2:20 p.m.–2:50 p.m.</td>
<td><strong>BREAK</strong></td>
<td></td>
</tr>
<tr>
<td>2:50 p.m.–3:20 p.m.</td>
<td>Biofilm method standardization: A regulatory perspective</td>
<td>Rebecca Pines, Biologist, Microbiology Laboratory Branch, Office of Pesticide Programs, US EPA</td>
</tr>
<tr>
<td>3:20 p.m.–3:50 p.m.</td>
<td>Public health biofilm claims for antimicrobial pesticide products: Pathways to registration</td>
<td>Alison Clune, Biologist, Antimicrobials Division, Office of Pesticide Programs, US EPA</td>
</tr>
<tr>
<td>3:50 p.m.–4:20 p.m.</td>
<td>European Union perspective on biofilm regulation</td>
<td>Minna Keinanen-Toivola, Faculty, Satakunta University of Applied Sciences, Rauma, Finland</td>
</tr>
<tr>
<td>4:20 p.m.–5:00 p.m.</td>
<td>Session 2 wrap up and panel discussion</td>
<td></td>
</tr>
</tbody>
</table>
### TECHNOLOGY TRANSFER:
**Beneficial-Biofilms Workshop**  
**January 31, 2017**  
**Arlington, VA**

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30 a.m.–8:15 a.m.</td>
<td>Registration and continental breakfast, Virginia Foyer, Plaza Level</td>
<td>Matthew Fields, CBE Director; Professor, Microbiology &amp; Immunology, MSU; Paul Sturman, CBE Industrial Coordinator</td>
</tr>
<tr>
<td>8:15 a.m.–8:30 a.m.</td>
<td>Welcome &amp; opening remarks, Washington ballroom</td>
<td>Matthew Fields, CBE Director; Professor, Microbiology &amp; Immunology, MSU; Paul Sturman, CBE Industrial Coordinator</td>
</tr>
<tr>
<td>8:20 a.m.–8:30 a.m.</td>
<td>Session introduction</td>
<td>Matthew Fields, CBE Director; Professor, Microbiology &amp; Immunology, MSU; Paul Sturman, CBE Industrial Coordinator</td>
</tr>
<tr>
<td>8:30 a.m.–9:00 a.m.</td>
<td>From forced cooperation to forced clumping: Multi-domain interactions with biofilms</td>
<td>Matthew Fields, CBE Director; Professor, Microbiology &amp; Immunology, MSU; Paul Sturman, CBE Industrial Coordinator</td>
</tr>
</tbody>
</table>
| 9:30 a.m.–10:00 a.m. | Characterizing multi-domain biofilms in biotechnology, the environment, and medicine | Robin Gerlach, Professor, Chemical & Biological Engineering, MSU, CBE |}

#### SESSION 1: Multi-Kingdom Biofilms

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00 a.m.–8:30 a.m.</td>
<td>Session introduction</td>
<td>Matthew Fields, CBE Director; Professor, Microbiology &amp; Immunology, MSU; Paul Sturman, CBE Industrial Coordinator</td>
</tr>
<tr>
<td>8:30 a.m.–9:00 a.m.</td>
<td>From forced cooperation to forced clumping: Multi-domain interactions with biofilms</td>
<td>Matthew Fields, CBE Director; Professor, Microbiology &amp; Immunology, MSU; Paul Sturman, CBE Industrial Coordinator</td>
</tr>
</tbody>
</table>
| 9:30 a.m.–10:00 a.m. | Characterizing multi-domain biofilms in biotechnology, the environment, and medicine | Robin Gerlach, Professor, Chemical & Biological Engineering, MSU, CBE |}

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Speaker</th>
</tr>
</thead>
</table>
| 10:00 a.m.–10:30 a.m. | Break                                                            | Gordon Ramage, Professor, School of Medicine, Dentistry and Nursing, University of Glasgow, Scotland |}

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Speaker</th>
</tr>
</thead>
</table>
| 11:00 a.m.–11:30 a.m. | Inter-kingdom oral biofilm interactions: Implications for pathogenesis and treatment | Gordon Ramage, Professor, School of Medicine, Dentistry and Nursing, University of Glasgow, Scotland |}
| 11:30 a.m.–12:00 a.m. | Discussion session                                                      | Garth James, Assoc. Research Professor, Chemical & Biological Engineering, MSU; Manager, Medical Biofilms Lab, CBE                     |
| 12:00 a.m.–12:30 p.m. | Catered Lunch, Adams                                                  | Garth James, Assoc. Research Professor, Chemical & Biological Engineering, MSU; Manager, Medical Biofilms Lab, CBE                     |

#### Session 2: Biofilms in Women’s Health

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:10 p.m.–1:20 p.m.</td>
<td>Session Introduction</td>
<td>Garth James, Assoc. Research Professor, Chemical &amp; Biological Engineering, MSU; Manager, Medical Biofilms Lab, CBE</td>
</tr>
<tr>
<td>1:20 p.m.–1:50 p.m.</td>
<td>Issues surrounding breast implant infection</td>
<td>Garth James, Assoc. Research Professor, Chemical &amp; Biological Engineering, MSU; Manager, Medical Biofilms Lab, CBE</td>
</tr>
<tr>
<td>1:50 p.m.–2:20 p.m.</td>
<td>Bacterial vaginosis</td>
<td>Elinor Pulcini, Assistant Research Professor, Chemical &amp; Biological Engineering, MSU, CBE</td>
</tr>
<tr>
<td>2:20 p.m.–2:50 p.m.</td>
<td>Methods to assess urinary catheters designed to reduce CAUTI</td>
<td>Darla Goeres, Associate Research Professor, Chemical &amp; Biological Engineering, MSU, CBE</td>
</tr>
<tr>
<td>2:50 p.m.–3:20 p.m.</td>
<td>Break</td>
<td>Garth James, Assoc. Research Professor, Chemical &amp; Biological Engineering, MSU; Manager, Medical Biofilms Lab, CBE</td>
</tr>
</tbody>
</table>
| 3:20 p.m.–3:50 p.m. | Women’s health and cosmetic device infections—A combinatorial approach to interrupting the pathogenesis process: Prevention, practice, and preservation | Eva Wang, ORISE Research Fellow, Center for Devices & Radiological Health, FDA |}
| 3:00 p.m.–4:00 p.m. | Discussion & Brainstorming Session                                   | Eva Wang, ORISE Research Fellow, Center for Devices & Radiological Health, FDA |
TECHNOLOGY TRANSFER:
NEWS HIGHLIGHTS

CBE welcomed new members to its Industrial Associates Program:

CleanSpot, Inc.
CleanSpot, Inc. is the maker of ActiveClean, the first moisturizing hand sanitizer made with natural ingredients to protect your skin from germs without drying out your skin. It is the first moisturizing hand sanitizer formulated with beeswax, which has been used as a moisturizer for centuries because it forms a natural moisturizing barrier on your skin. CleanSpot’s representative to the CBE is Chuck Call. For more information on the company, go to: www.activeclean.com

DeLaval
The CBE recently welcomed DeLaval as its newest Industrial Associate member. DeLaval is a world leader in the dairy farming industry, providing integrated milking solutions designed to improve dairy farmers’ production, animal welfare, and overall quality of life. The company develops, manufactures, and markets equipment for milk production and animal husbandry worldwide. Carolina Mateus, DeLaval R&D Manager, is the CBE designated representative. Read more about DeLaval at: www.delavalcorporate.com

S.C. Johnson & Son
Founded in 1886, S.C. Johnson is a family-owned company and one of the world’s leading producers of household brands. Their product portfolio is vast and includes global brands that help every household with cleaning, pest control, storage, shoe and auto care, and home fragrance. The CBE designated representative at SCJ is Deliang Shi. To read more about SCJ visit their website at www.scjohnson.com/en/home.aspx

Smith & Nephew
Smith & Nephew is a global medical technology company that supports healthcare professionals with pioneering designs of advanced medical products. Their products and services include: joint replacement systems for knees, hips and shoulders; wound care treatment and prevention products for hard-to-heal wounds; instruments and technologies for minimally invasive joint surgery; and products used to repair bone fractures. Smith & Nephew’s CBE designated representative is Paul Renick. To read more about the company, go to www.smith-nephew.com/about-us

Solvay
Solvay is a specialty chemical company that was created in 1863 as a start-up enterprise for manufacturing sodium carbonate. Today, Solvay offers a wide range of products designed for food service, building products, consumer goods, and other industrial applications. Solvay’s representatives to the CBE are Gilda Lizarraga and Jaime Hutchison. To read more about the company, visit their website at: www.solvay.com/en/index.html

Sharklet Technologies
Sharklet is the world’s first technology to inhibit bacterial growth through pattern alone. The Sharklet surface is comprised of millions of microscopic features arranged in a distinct diamond pattern. The structure of the pattern alone inhibits bacteria from attaching, colonizing and forming biofilms. Sharklet contains no toxic additives or chemicals, and uses no antibiotics or antimicrobials. Sharklet’s representative to the CBE is Ethan Mann. To view more about the company including a video on PBS’ Nova series, visit their website at: www.sharklet.com/

View the list of CBE Industrial Associates
Read about CBE membership
**EPA is seeking public comment on proposed test methods for antimicrobial efficacy**

In October 2016, the EPA announced that it was seeking public comment on two test methods and guidance for evaluating antimicrobial efficacy against biofilm bacteria in hospital settings. CBE’s Standardized Biofilm Methods Laboratory (SBML) was part of the academic and industrial team that developed the test methods by providing statistical support, interlaboratory study design and analysis, and guidance through the standardization process at the American Society for Testing and Materials (ASTM). The SBML has worked with the EPA for over 20 years measuring how well anti-bacterial products perform against biofilm bacteria in both household and hospital settings. Below is the full press release from the EPA.

Press release from the EPA, October 4, 2016:

EPA is seeking public comment on two proposed test methods and associated testing guidance for evaluating antimicrobial pesticides against two biofilm bacteria, Pseudomonas aeruginosa and Staphylococcus aureus.

Bacterial biofilms excrete a slimy, glue-like substance (extracellular polymeric substances, called the biofilm matrix) that facilitates attachment to many hard surfaces such as glass, metals, and plastics, including those in health-care settings. The biofilm matrix provides embedded bacteria with protection from dehydration and other environmental stresses and interferes with the action of chemical disinfectants. Under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), the registrant of an antimicrobial product with a public health claim is required to submit efficacy data to EPA in support of the product’s registration. EPA is soliciting comments on the clarity of the standard operating procedures and the regulatory guidance. Comments will be collected until December 5, 2016, at which point the EPA will finalize the procedures and provide the revised methods for use. The methods, guidance, and additional background documents are available in docket EPA-HQ-OPP-2016-0357 at [www.regulations.gov](http://www.regulations.gov).

**Expert panel advises aggressive initial treatment for patients with chronic wounds**

Garth James, manager of the CBE’s Medical Biofilms Laboratory, participated in an international biofilm expert panel that included leading researchers from Australia, Denmark, Japan, United Kingdom, and the United States. Convened by CBE industrial member Smith & Nephew, a major medical manufacturing company based in London, the Global Wound Biofilm Expert Panel recently called for physicians around the world to reverse the longstanding practice of gradually escalating treatment of patients with chronic wounds.

“We are recommending physicians change course and start treating chronic wounds very aggressively initially,” James says. “This is the exact opposite of traditional wound-care practice where you try something minimally invasive then get increasingly aggressive as needed.”

The recommendation for the new treatment protocol appears in the cover story of January 2018 online edition of *Wound Repair and Regeneration* titled “Consensus guidelines for the identification and treatment of biofilms in chronic nonhealing wounds.”

In 2017, the expert panel published an article titled, “The prevalence of biofilms in chronic wounds: a systematic review and meta-analysis of published data,” in the January 2017 edition of the *Journal of Wound Care*. 

Appendix ToC
TECHNOLOGY TRANSFER:
Industry and Agency Interactions

CBE visits to industry & agencies

May 18, 2016: Diane Walker, CBE research engineer, met with Cliff Bradley, president of Montana BioAgriculture, Inc. and Andrea Stierle, research professor in University of Montana’s Department of Biomedical & Pharmaceutical Sciences. Diane discussed potential collaborative projects.


The following CBE faculty made industry visits to discuss membership in the Industrial Associates Program:

Phil Stewart visited Smith & Nephew in Fort Worth, Texas, September 22, 2016.


March 2, 2017: Darla Goeres visited S.C. Johnson in Racine, WI to discuss CBE membership and present “Standardized biofilm methods development: Approach & applications.”

Industry & agency visits to CBE

May 19, 2016: Garth James, associate professor in chemical and biological engineering, hosted Dr. Ondrej Slaby of Masaryk University Central European Institute of Technology, in Brno, Czech Republic, and Dr. Manu N. Kapoor of Rockefeller University Lab of Bacterial Pathogenesis and Immunology, in New York, New York. The guests toured the Center and discussed possible testing projects.

January 26, 2017: Paul Sturman, CBE industrial coordinator, hosted Ricky Woofter, research chemist with Lubrizol. Lubrizol is a specialty chemical company that makes additives and coatings for automotive, personal and home care and oilfield applications. Woofter toured the CBE labs and met with several CBE faculty and researchers to discuss potential projects and membership.

February 28–March 1, 2017: Diane Walker, CBE research engineer, hosted a two-day workshop for Eunice Aquino and Amanda Faltynowski from member company DeLaval. The workshop covered the steps involved in working with the CDC Biofilm Reactor.

March 21, 2017: Darla Goeres, associate research professor, chemical and biological engineering, hosted Dan Sannito and Kevin Brandimarte from Keurig Green Mountain Roasters. The group spent their time working in the Standardized Biofilm Methods Lab investigating coffee brewers.

April 6–7, 2017: CBE Standardized Biofilm Methods Lab hosted Chuck Skypeck and Josh VanZee from the National Brewers Association and Atwain Atwain from NSF International. The group met to discuss their project on biofilms in beer draught lines.

April 10–11, 2017: Matthew Fields, CBE director, along with MSU’s College of Engineering and the Alumni Foundation, hosted Jerry Kovacich, Dan Tyndall, and Sarah Ruddell from Carbon Cycle Energy of Boulder, Colorado. Carbon Cycle is a renewable energy development company that converts organic agricultural and industrial food waste into pipeline-grade biomethane for direct injection into the natural gas pipeline system. The group met with several faculty and administrators from across MSU’s campus. They also discussed potential projects with CBE researchers. Kovacich, the company’s CEO, graduated from MSU with a degree in chemical engineering.
OUTREACH:

News highlights

Online training videos
The CBE’s Standardized Biofilm Methods Lab has spent the last year developing and producing a series of videos for the world to watch and learn from. These videos teach methods for repeatable biofilm growth and sampling techniques, and offer the visualization of some of these standardized techniques. The latest of these videos is the Drip Flow Biofilm Reactor Training Video. Find this and other videos at: www.biofilm.montana.edu/standardized-biofilm-methods-training-videos.html

MSU American Indian Research Opportunities (AIRO) BRIDGES program
James Vallie worked at the CBE in summer 2016 as part of the American Indian Research Opportunities (AIRO) BRIDGES program. The program’s objective is to build an educational experience between reservation-based colleges and Montana State University and, in the process, increase the number of underrepresented Native American students successfully transferring from the two-year tribal colleges to MSU and pursuing academic studies in the biomedical and other health-related sciences. Vallie earned his associates degree in business from Little Big Horn College in Crow Agency, Montana. While in the BRIDGES program, he studied algal biofuels under Dr. Brent Peyton, professor of chemical and biological engineering. Vallie is now enrolled as a student at Montana State University and will continue his work studying alternative fuel resources.

CBE visiting researcher explains black film on Jefferson Memorial
Dr. Federica Villa, long-time CBE visiting researcher from the University of Milan, was featured in an article in the Washington Post. The article “A grimy, black biofilm is starting to cover the Jefferson Memorial, and it can’t be killed,” focuses on the research that Villa and her collaborators at the US National Park Service are doing on national monuments. They are evaluating the black film that is appearing on many stone monuments and if the film will cause damage to the structures or could be a protective barrier. Read more at the Washington Post: “A grimy, black biofilm is starting to cover the Jefferson Memorial, and it can’t be killed”

Visiting Researchers

Visiting Student Researchers
The CBE welcomed the following visiting students conducting research with faculty during the 2016–2017 academic year:

Kristina Block, Masters student
Hometown: Berlin, Germany
Area of study & home university: Environmental Engineering, Berlin Technological University
Research at the CBE: Use of struvite from different sources (synthetic, biogen, and wastewater) as an alternative nutrient for cultivation of algae
CBE Host: Robin Gerlach, professor, chemical & biological engineering

Marta Bottagisio, PhD student
Hometown: Milan, Italy
Area of study & home university: Veterinary biotechnology, University of Milan, Italy; Affiliate of the IRCSS Galeazzi Orthopedic Institute in Milan
Research at the CBE: Protein expression in Staphylococcus epidermidis biofilms grown on titanium
CBE host: Garth James, associate research professor, chemical and biological engineering; manager, CBE medical biofilms laboratory

Marketta Hulkova, Fulbright PhD student
Hometown: Brodek u Přerova, Czech Republic
Home university: Masaryk University, Brno, Czech Republic
Research at the CBE: Ecotoxicity of silver nanomaterials
CBE Host: Ross Carlson, professor, chemical & biological engineering

Luiz Pereira Da Silva Jr., Undergraduate student
Hometown: Recife, Pernambuco, Brazil
Area of study, home university: Wastewater systems and constructed wetlands, Federal University of Pernambuco, Brazil
CBE hosts: Ellen Lauchnor, assistant professor, and Otto Stein, professor, both in civil engineering
Sepideh Ebadi, PhD student  
Hometown: Tehran, Iran  
Area of study, home university: Biomathematics, Florida State University, Tallahassee, Florida  
CBE Host: Jim Wilking, assistant professor, chemical & biological engineering

Maria Clara Tarifa, PhD student  
Hometown: Bahia Blanca, Buenos Aires, Argentina  
Area of study, home university: Biology, Universidad Nacional Del Sur, Bahia Blanca, Buenos Aires, Argentina  
Research at the CBE: Microrheology of yeast biofilms  
CBE Supervisor: Phil Stewart, professor, chemical & biological engineering

James Vallie, Undergraduate Student  
Hometown: Hardin, Montana  
Area of study, home university: Alternative fuel sources, Little Big Horn College, Hardin, Montana

CBE Supervisor: Brent Peyton, professor, chemical & biological engineering

Visiting Research Faculty

Greg Characklis, Professor, Environmental Sciences and Engineering, School of Global Public Health, University of North Carolina at Chapel Hill  
Research area: Algal biofuels  
CBE host: Robin Gerlach, professor, chemical and biological engineering

Birthe Venø Kjellerup, Assistant Professor, Civil & Environmental Engineering, University of Maryland, College Park  
Research area: Biofilms in complex microbial systems  
CBE host: Phil Stewart, professor, chemical and biological engineering

CBE Tours

July 24, 2016: CBE hosted a tour for fifteen undergraduates from the China University of Geosciences in Beijing. Their visit was sponsored by MSU’s Office of International Programs. The tour was led by Shipeng Lu, CBE postdoctoral researcher and Kristen Brileya, CBE technical operations manager.

October 25, 2016: John Delaney, executive director for research at Amgen, toured the CBE while visiting Montana State University to discuss possible collaborative projects with the Department of Microbiology & Immunology and the College of Engineering. Amgen is one of the world's leading biotechnology companies.

October 25, 2016: MSU President Waded Cruzado was joined by MSU administrators Renee Reijo-Pera, vice president of research, Bob Mokwa, provost, and Brett Gunnink, dean of the College of Engineering for a tour of the CBE. This was Dr. Cruzado's second tour of the center since joining MSU in January 2010. She heard directly from students and staff, in their laboratories, about diverse projects related to algal biofuels, chronic wounds, metabolic exchanges between species, and standardized biofilm methods. After the tour, the group met with the CBE executive committee for a CBE overview on student education, interdisciplinary research, and technology transfer.

May 2, 2017: Matthew Fields, CBE director, and Paul Sturman, CBE industrial coordinator, hosted a tour for Greg Zikos and Freddie Daver from the Alfred E. Mann Institute for Biomedical Engineering (AMI) at the University of Southern California. AMI’s mission is to help bridge the gap between biomedical innovation and the creation of commercially successful medical products to improve public health. Zikos and Daver were visiting Montana State University and stopped by the CBE to learn more about the Center and discuss possible collaborative projects.
OUTREACH:

**Web image library use 2016-2017**

Total image downloads: **347**

Requests for CBE graphics were submitted from **31** of the U.S. states and Puerto Rico:

- Alabama
- Arkansas
- California
- Colorado
- Florida
- Georgia
- Idaho
- Illinois
- Indiana
- Kentucky
- Maryland
- Massachusetts
- Michigan
- Minnesota
- Missouri
- Montana
- New Hampshire
- New Jersey
- New York
- North Carolina
- Ohio
- Oklahoma
- Oregon
- Puerto Rico
- Rhode Island
- South Carolina
- Texas
- Virginia
- Washington
- Wisconsin

There were requests from an additional **35** countries:

- Argentina
- Australia
- Austria
- Belgium
- Brazil
- Canada
- Chile
- China
- Colombia
- Costa Rica
- Croatia
- Denmark
- Finland
- France
- Germany
- India
- Iran
- Iraq
- Ireland
- Italy
- Japan
- Malaysia
- Mexico
- New Zealand
- Nigeria
- Norway
- Portugal
- Saudi Arabia
- Singapore
- South Africa
- Spain
- Sweden
- Switzerland
- Tunisia
- United Kingdom
FACILITIES:

Center for Biofilm Engineering Facilities Overview
The CBE moved into MSU’s former Engineering and Physical Sciences Building when it was built in 1997. Now Barnard Hall, the building was renamed after a private donation was made in 2016 which contributed toward remodeling common areas and the building exterior. The >20,000 ft² facility includes offices and conference rooms for faculty, staff, and students; a computer lab; and thirteen fully equipped research laboratories. The full-time CBE Technical Operations Manager oversees the research laboratories, provides one-on-one training for students, ensures safe laboratory practices, and maintains equipment. State-of-the-art instruments and equipment are available for use by all CBE faculty, staff, and students. General use areas include an analytical instrument lab, a microbiology lab with media preparation area and autoclaves, and a general molecular area with two thermocyclers, a gel running and imaging station, as well as an isolated radioactive isotope lab. Facilities of particular note are described below.

Mass Spectrometry Facility
In 2005 an equipment grant was awarded for an Environmental and Biofilm Mass Spectrometry Facility through the Department of Defense University Research Instrumentation Program (DURIP). The grant funded the acquisition of an Agilent 1100 series high performance liquid chromatography system with autosampler and fraction collector, an Agilent SL ion trap mass spectrometer, and an Agilent 6890 gas chromatograph (GC) with electron capture detector, flame ionization detector, and 5973 inert mass spectrometer. Since then, an Agilent 7500ce inductively coupled plasma mass spectrometer with autosampler, liquid, and gas chromatographic capabilities have been added as well as an additional Agilent 1100 series high performance liquid chromatography system with autosampler and an Agilent 6890 GC with autosampler and flame ionization detector. The chromatographs and mass spectrometers are very well suited for unknown compound identification and high sensitivity speciation measurements of organic and inorganic compounds; this equipment enhances the CBE’s research capabilities significantly. The Environmental and Biofilm Mass Spectrometry Facility is operated as a user facility and allows access for academic and non-academic researchers.

Microsensor Laboratory
The Microsensor Laboratory provides the capability of measuring microscale chemical and physical parameters within biofilms, microbial mats and other compatible environments. The Microsensor Laboratory has the capability to measure spatial concentration profiles using sensors for oxygen, pH, hydrogen sulfide, nitrous oxide and some custom-made electrodes. All electrodes are used in conjunction with computer-controlled micromanipulators for depth profiling. A Leica stereoscope is used to visualize the sensors while positioning them on the biofilm surface. The laboratory has experience with diverse microsensor applications including biofilms in wastewater, catheters and hollow fiber membrane systems in addition to algal and fungal biofilms.

Microscope Facilities
The microscopy facilities are coordinated by the Microscopy Facilities Manager who maintains the equipment and trains and assists research staff and students in capturing images of in situ biofilms via optical microscopy and fluorescent confocal microscopy. The microscopy facilities include three separate laboratories—the Optical Microscopy Lab, the Confocal Microscopy Lab, and the Microscope Resource Room and Digital Imaging Lab—which are detailed below.

The Optical Microscopy Lab houses two Nikon Eclipse E-800 research microscopes which are used for transmitted light and epi-fluorescent imaging. Both microscopes are equipped with Photometrics MYO cooled CCD cameras and use Universal Imaging Corporation’s MetaVue software (v 7.4.6) for digital image acquisition. We have a large collection of fluorescence filter cubes for the Nikons, including those optimized for the following fluorescent stains: FITC (gfp), TRITC (propidium iodide), DAPI, CTC, ELF-97, CY5, cfp, and we also have a B2E cube. Both Nikons are equipped with Nomarski/DIC, and we have a 100x oil phase contrast objective and condenser especially for use with imaging spores.
Our microscope collection has expanded with the acquisition of a new Leica M 205 FA computer-controlled stereomicroscope and a Leica DFC3000G fluorescence camera. This stereoscope can be used to image samples using fluorescence, brightfield with or without polarization or Rotterman contrast, and reflected white light. The software will also allow a z-stack of images to be collected and recomposed using simple deconvolution. Other equipment in the Optical Microscopy Lab includes a Nikon SMZ-1500 barrel zoom stereomicroscope equipped with a color camera, a Leica CM1800 cryostat, a Zeiss Palm Laser Capture Dissection microscope and a dry ice maker.

The **Confocal Microscopy Lab** contains two fairly new (2011) Leica SP5 Confocal Scanning Laser Microscopes (CSLMs). One is an inverted confocal microscope with 405, 488, 561 and 633 nm laser excitation lines. It is equipped with a tandem scanner, so it can be switched from standard scanning mode to operate in Resonant Scanner mode, which enables scanning at exceptionally high frequencies for fluorescent imaging. This faster scanning is necessary for most live cell imaging (note: “live cell imaging” doesn’t generally refer to imaging bacterial cells, but rather mammalian cells and processes). This inverted SP5 also includes a heated stage with an environmental control chamber (i.e. it can be used to provide an enclosed CO2 atmosphere), and a motorized stage with Mark-and-Find and image tiling capabilities.

The second new SP5 is an upright confocal microscope, also with 405, 488, 561 and 633 nm lasers, a motorized stage, Mark-and-Find, and tiling capabilities. This upright has a removable heated chamber that encloses the entire microscope, so that larger, incubated flow cell systems can be accommodated over long periods of time. This enables high-resolution time-lapse monitoring of biofilm development, treatment and detachment phenomena. Additionally, this microscope is equipped with Fluorescence Lifetime Imaging (FLIM) capability, which is also referred to as Single Molecule Detection.

The CSLM is capable of imaging biofilms on opaque surfaces, so a wide variety of materials can be used in the experimental flow cells. As biofilm formation proceeds in an experiment, representative areas of the colonized surface are scanned with the use of the automatic stage. Digital data is collected from sequential scans, and stored data can be viewed in the x, y, z coordinates to yield a 3-dimensional image of the biofilm architecture. Quantitative and qualitative information about biofilm architecture can be retrieved easily from examination of CSLM data, in both the x-y and x-z planes, and the existence or absence of structural features, such as microcolonies and water channels, can be determined.

The **Microscope Resource Room / Digital Imaging Lab** is where CBE researchers examine and reconstruct the stacks of image data they have collected using our image analysis software. For quantitative analysis, such as intensity or particle-size measurements, we use Universal Imaging Corporation’s MetaMorph software. We use Bitplane’s Imaris software for computer-intensive data analysis like particle tracking and for qualitative analysis—for example, putting together a stack of 200 red and green flat images to get a 3-dimensional image of a biofilm microcolony that can be rotated in space and examined from every angle. The lab consists of three dedicated computers, a server for storing large files, CD and DVD burners and readers, and a color printer. In addition to providing CBE students, staff, and researchers with an imaging workplace, the resource room gives us a place to hold group tutorials and WebEx group software training sessions.

**Computer Facilities**

The CBE maintains several dedicated computational and data storage computer systems including high performance data and image analysis workstations and large storage servers. The CBE maintains a small to mid-scale computational cluster for modeling and analysis. The center provides personal workstations for staff and graduate students that are connected to the MSU computer network. A student computer laboratory offers eight state-of-the-art PCs along with scanning and printing services. Additionally, CBE staff and students have access to the centrally maintained computational cluster for data manipulation, analysis, and mathematical modeling. This cluster consists of 65 nodes with a total of 1080 hyper-threaded cores and 18 teraflops of computing power.
SPECIALIZED CBE RESEARCH GROUPS

Ecology/Physiology Laboratory
The Ecology/Physiology Laboratory headed by Dr. Matthew Fields has general microbiology equipment, anaerobic gassing stations in two lab spaces, Shimadzu UV-VIS spectrophotometer, Ultra-Centrifuge, Anaerobic Chamber, biofilm reactors, protein and DNA electrophoresis, Qubit fluorometer, two Eppendorf Mastercylercs, incubators, laminar/fume hoods, microcentrifuges, table-top centrifuges, and a microcapillary gas chromatograph with dual TCDs. The lab has two light-cycle controlled photo-incubators as well as photo-bioreactors for the cultivation of algae and diatoms, and maintains two -20°C freezers and three -70°C freezers for sample storage.

This laboratory houses an Illumina MiSeq Sequencing System. The MiSeq desktop sequencer allows the user to access more focused applications such as targeted gene sequencing, metagenomics, small genome sequencing, targeted gene expression, amplicon sequencing, and HLA typing. This system enables up to 15 Gb of output with 25 M sequencing reads and 2x300 bp read lengths by utilizing Sequencing by Synthesis (SBS) Technology. A fluorescently labeled reversible terminator is imaged as each dNTP is added, and then cleaved to allow incorporation of the next base. Since all 4 reversible terminator-bound dNTPs are present during each sequencing cycle, natural competition minimizes incorporation bias. The end result is true base-by-base sequencing that enables the industry's most accurate data for a broad range of applications. The method virtually eliminates errors and missed calls associated with strings of repeated nucleotides (homopolymers).

Medical Biofilm Laboratory
The Medical Biofilm Laboratory (MBL) has earned a reputation for being a university lab that responds quickly to real world needs in the area of health care as it relates to biofilms. Dr. Garth James (PhD, microbiology), Randy Hiebert (MS, chemical engineering), and Dr. Elinor Pulcini (PhD, microbiology) have been the innovative leaders and managers of this respected, flexible, and adaptable lab group. The MBL team also includes a full-time research professor, three technicians, and one undergraduate research assistant.

Currently, twelve companies, including CBE Industrial Associates, sponsor MBL projects. These projects include evaluating antimicrobial wound dressings, biofilm formation on biomedical polymers, testing novel toothpaste ingredients, and testing biofilm prevention and removal agents. The MBL is also researching the role of biofilms in Lyme disease with funding from a private foundation. The MBL is a prime example of integration at the CBE, bringing together applied biomedical science, industrial interaction, and student educational opportunities.

Standardized Biofilm Methods Laboratory
The Standardized Biofilm Methods Laboratory (SBML) was designed to meet research and industry needs for standard analytical methods to evaluate innovative biofilm control technologies. SBML staff and students develop, refine, and publish quantitative methods for growing, treating, sampling, and analyzing biofilm bacteria. The SBML members work with international standard setting organizations (AOAC International, ASTM International, IBRG, and OECD) on the approval of biofilm methods by the standard setting community. Under a contract with the U.S. Environmental Protection Agency (EPA), the SBML provides statistical services relevant to the EPA’s Office of Pesticide Programs Microbiology Laboratory Branch to assess the performance of antimicrobial test methods— including those for biofilm bacteria. The SBML received funding from the Burroughs Wellcome Foundation to develop a method for assessing the prevention of biofilm on surface modified urinary catheters. In addition, they conduct applied and fundamental research experiments and develop testing protocols for product specific applications. Methods include: design of reactor systems to simulate industrial/medical systems; growing biofilm and quantifying microbial abundances and activity; testing the efficacy of chemical constituents against biofilms; and microscopy and image analysis of biofilms. SBML staff offer customized biofilm methods training workshops for CBE students, collaborators, and industry clients.

Microbial Ecology and Biogeochemistry Laboratory
Research in the Microbial Ecology and Biogeochemistry Laboratory lies at the intersection of microbial and ecosystem ecology and uses a combination of field and laboratory studies, as well as approaches ranging from the single-cell to the community level. Staff in this lab are interested in understanding how the environment controls the composition of microbial communities and how, in turn, those microbes regulate whole ecosystem processes such as nutrient and organic matter cycling.
Appendix ToC

Ongoing research examines carbon flux through microbial communities, with the long-term goal of improving predictions of carbon fate (metabolism to CO₂, sequestration into biomass, long-term storage in ice) in the context of a changing environment. Additionally, they are interested in physiological adaptations to life in icy environments. Regardless of the environment, the group employs microbiological, limnological, biochemical and molecular biology approaches to investigate fundamental processes carried out by microbes.

**Microfluidics Laboratory**

Connie Chang runs a soft matter and microfluidics laboratory that focuses on drop-based microfluidics, the creation and manipulation of picoliter-sized drops of fluid for ultra high-throughput screening and assaying. The Chang lab is interested in 1.) developing new experimental methods for the screening and analysis of large numbers of cells or microorganisms and 2.) the creation of colloidal particles for applications in medicine, pharmaceuticals, oil recovery, catalysis, and encapsulation technology in food and cosmetics.

The photolithography portion of the lab houses a spin-coater, plasma cleaner, UV light source, and two hot plates for post-baking. The glass capillary microfluidics portion of the lab houses a pipette puller and microforge. The PDMS microfluidics portion of the lab contains a droplet sorting and detection stand composed of an inverted light microscope mounted on an optical table, syringe pumps, a fast camera, lasers, high voltage amplifier, photomultiplier tubes, and all of the necessary data acquisition components to interface with LabVIEW control software for droplet sorting and detection.

**OTHER Montana State University facilities available for collaborative research**

**Montana Nanotechnology (MONT) Facility**
The MONT facility was formed from a $3 million NSF grant awarded to MSU in September of 2015. This collaborative facility includes the Montana Microfabrication Facility (MMF), the Imaging and Chemical Analysis Lab (ICAL), the CBE, the MSU Mass Spectrometry facility, and the Center for Bio-Inspired Nanomaterials. MONT provides researchers from academia, government and companies large and small with access to university facilities with leading-edge fabrication and characterization tools, instrumentation and expertise within all disciplines of nanoscale science, engineering and technology.

**Montana Microfabrication Facility (MMF)**
The Montana Microfabrication Facility is a cleanroom user facility located at MSU-Bozeman. As part of the NSF NNCI consortium MMF is a user facility open to university students and faculty as well as extramural users from industry and academia. The MMF facility comprises three separate areas: the EPS cleanroom, the Cobleigh process cleanroom and the Cobleigh packaging room. The EPS facility is a 1500 sq. ft. lab consisting of a class 1000 lithography area and a class 1000 general processing area. The Cobleigh process facility is a 500 sq. ft. class 10,000 lab that is home to MMF’s PVD deposition tools and the packaging room is a 200 sq. ft., class 10,000 softwall cleanroom. The labs are located in adjacent, connected buildings. MMF supports education, research, and development work in nano and microfabrication areas. **Current major equipment:**

**Photolithography**
- ABM- contact aligner
- EVG 620 contact aligner
- Brewer Cee100 spin coater
- Headway PMW32 spin coater

**Etching**
- Oxford ICP Plasmalab 100
- March 1703 RIE
- PVA Tepla Ion 10 asher
Montana State University Center for Biofilm Engineering
2017 APPENDIX

Appendix ToC

Deposition
- Amod 4-pocket e-beam evaporation system
- Angstrom Engineering RF and DC sputtering system
- Modulab thermal evaporator

Metrology
- Ambios XP2 profilometer
- Gaertner L116 ellipsometer
- Filmetrics F3 reflectance spectrometer
- Jandel 4-point probe
- Nikon Eclipse L150 inspection microscope
- Wild stereo microscope

Packaging
- K&S 4523 wedge bonder
- K&S 4124 ball bonder

Furnaces
- MRL oxidation
- MRL solid source diffusion furnaces: boron and phosphorus
- ATV PEO603

MSU ICAL Laboratory
The Image and Chemical Analysis Laboratory (ICAL) at Montana State University is located on the 3rd floor of the EPS Building, adjacent to the Center for Biofilm Engineering. ICAL is a core user facility that fosters interdisciplinary collaboration and supports basic and applied research and education in all science and engineering disciplines at MSU and in the surrounding area. The laboratory provides users from academic and government institutions and the private sector with access to state-of-the-art equipment, professional expertise, and individual training. ICAL instrumentation is dedicated to the characterization of materials through high-resolution imaging and spectroscopy. The recent addition of a state-of-the-art Auger nanoprobe with EBSD and EDX opens up unique and transformative material characterization capabilities. This system enables the simultaneous submicron analysis of surface and bulk composition, identification of crystal phase and crystallographic orientation, and measurement of strain on precisely the same spot at nearly the same time, which elevates the capabilities of the research groups in the region to the next level.

Current Instrumentation
- Atomic Force Microscopes (AFMs)
- Field Emission Scanning Electron Microscope with EBSD (FE SEM/EBSD)
- Scanning Electron Microscope with EDX (SEM/EDX)
- X-ray Photoelectron Spectrometer with cryo-stage (XPS)
- Time-of-Flight Secondary Ion Mass Spectrometer (ToF-SIMS)
- X-Ray powder Diffraction Spectrometer (XRD)
- Field Emission Scanning Auger Nanoprobe (FE AUGER/EDX/EBSD)
- Epifluorescence Optical Microscope
- Critical point drying
- Contact angle system
- Zeta Potential system

For more information on each system, see the ICAL website at: www.physics.montana.edu/ical/

MSU Proteomics, Metabolomics, Mass Spectrometry Facility
The mission of the Proteomics, Metabolomics, Mass Spectrometry Facility is to seed methods, technology, and applications to research labs at Montana State University and the Greater Northern Rockies. This facility offers a full range of services from single samples to complete proteomics and metabolomics projects. Currently there are 9 instruments including GCMS, MALDI-TOF, ESI-QTOF, and ESI-IonTrap configurations. Periodic hands-on training sessions are offered by the facility staff. The goal of the training modules is to expand facility access to researchers with little or no previous training in proteomics, metabolomics, or mass spectrometry. Individual training can also be arranged. We also work closely with the NMR facility at
Montana State University Center for Biofilm Engineering

2017 APPENDIX

Appendix ToC

MSU in compound identification and metabolomics taking advantage of coupled LC-SPE-NMR-MS instrumentation. Please contact the facility personnel listed below if you wish to discuss training or submit samples for analysis.
Facility Manager: Dr. Ganesh Balasubramanian, ganesh@montan.edu
Facility Director: Dr. Brian Bothner, bbothner@montana.edu

MSU Magnetic Resonance Microscopy (MRM) Facility

A state-of-the-art MRM facility is available on a recharge basis for research projects. This facility is located in the College of Engineering in the same building as the Center for Biofilm Engineering. Both instruments in the facility are Bruker Avance instruments. The facility houses 250 MHz standard/wide bore and a 300 MHz wide/super-wide bore instruments for imaging and fluid dynamics applications. The imaging systems are capable of generating NMR image and transport data with spatial resolution on the order of 10 μm in a sample space up to 6 cm diameter.

MSU High Field Nuclear Magnetic Resonance (NMR) Facility

A state-of-the-art solution NMR facility is available on campus a short 5-minute walk from the College of Engineering and CBE laboratories. The Department of Chemistry and Biochemistry NMR facility is located on the bottom floor (rm# 18), and currently houses four NMR spectrometers. These include two easily accessible walk-in use older NMR spectrometers: A two-channel Bruker DPX 300 MHz NMR equipped with a room temperature 5mm QNP probe for detection of 1H, 13C, 31P and 19F nuclei, and an Oxford AS 500 MHz NMR coupled to a Bruker Avance I console utilized with several room temperature probes (e.g. a 5 mm BBI broadband inverse (13C, 1H, H2) probe, a 5 mm QNP (1H, 13C, 31P/19F) probe, a 3 mm (1H, 1H, 13C) Protasis Microcoil probe and a Bruker (2H,1H,13C) Flow probe. Both of these NMR’s are used for routine organic and bioinorganic work, and occasionally for characterization of metal ion clusters.

In September of 2016, the NMR facility received and installed a brand new Bruker Ascend 500 MHz (1H Larmor Frequency) NMR. This instrument is equipped with an Advance III console and a liquid nitrogen cooled broadband BBO (500S1 BB-H&E-05 2) prodigy Cryoprobe. This instrument is designed for enhanced carbon detection along with several other NMR active nuclei. The instrument is also equipped with an automatic sample loading system (SampleJetTM) for high-through-put sample analysis.

Finally, the 600 MHz (1H Larmor Frequency) NMR spectrometer was upgraded in 2011 from a DRX to an AVANCE III spectrometer, and is equipped with a helium-cooled 1H-optimized, inverse detection, (1H, 15N, 13C) TCI cryoprobe and a SampleJet™ automatic sample loading system. The 600 MHz NMR is dedicated to protein structure determination, characterization of macromolecular complexes (protein-protein or protein-nucleic acid interactions), protein dynamics studies (using 15N and 13C NMR relaxation approaches) and, more recently, is being used for broadly based untargeted NMR metabolomic analyses and structural characterization of unknown metabolites. The TCI cryoprobe installed on MSU’s 600 MHz NMR provides a significant increase in sensitivity for the NMR experiments (>4 fold, amounting to a > 16 time saving in data acquisition time requirements for low mM concentration samples). It also allows for detection of low abundance metabolites in sub-micromolar concentrations.

Acquisition of the two cryoprobes in the NMR facility has opened new research opportunities for identification of small molecules such as metabolites that may be present in low concentrations, and together with the 500MHz and 600 MHz opens new avenues for automated high-throughput profiling of metabolites (for example the SampleJet has five positions for 96 well-plate sized NMR tube racks. This allows the loading of to 480 sample tubes. It also accommodates and provides 96 positions for standard 3 mm and 5 mm NMR tubes). The NMR facility has access to several multi-user license (> 5) to operate the Chenomx™ metabolite profiler software required to process and analyze NMR metabolomics data has been purchased.

In addition to the above NMR’s, the NMR facility has a state of the art LC-MS-SPE-NMR system. This system couples highperformance liquid chromatography (HPLC) with real-time mass spectrometry (MicroTof) and UV detection to allow for unknowns or metabolites/small-molecule organics of interest to be captured on solid-phase extraction columns which can then be dried and automatically filled into NMR tubes for subsequent NMR analysis.

For more information, contact Dr. Valérie Copié, Professor of Chemistry and Biochemistry, and Director of MSU’s High Field NMR Center at vcopie@montana.edu, and Dr. Brian Tripet, Full-time NMR Facility Manager and Research Professor at brian.tripet@montana.edu